United States Department of the Interior
Bureau of Land Management
Royal Gorge Field Office
3028 E. Main Street
Cañon City, CO 81212

ENVIRONMENTAL ASSESSMENT

Noble East Pony Oil and Natural Gas Development Project

DOI-BLM-CO-F02-2014-052 EA

July 2015

BLM

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ACRONYMS AND ABBREVIATIONS

AADT	Annual Average Daily Traffic
APCD	Air Pollution Control Division
APD	Application for Permit to Drill
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
bgs	Below Ground Surface
BLM	Bureau of Land Management
BMP	Best Management Practice
°C	Degrees Celsius
CAA	Clean Air Act
CCR	Colorado Code of Regulations
CDOT	Colorado Department of Transportation
CEQ	Council on Environmental Quality
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
COA	Conditions of Approval
COGCC	Colorado Oil and Gas Conservation Commission
CPW	Colorado Parks and Wildlife
CRS	Colorado Revised Statutes
dBA	decibel
DOI	Department of Interior
DOLA	Department of Local Affairs
E&P	Exploration and production
EA	Environmental Assessment
EO	Executive Order
EFM	Electronic flow meter
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERL	Extended reach lateral
ESA	Endangered Species Act
°F	Degrees Fahrenheit
FLPMA	Federal Land Policy and Management Act
GAP	Gap Analysis Program
GHG	Greenhouse gas
GMU	Game Management Unit
gpm	Gallons per minute
HAP	Hazardous air pollutant
HDPE	High-density polyethylene
hp	Horsepower
HUC	Hydrologic Unit Code
ID	Interdisciplinary
IM	Instruction Memorandum
LACT	Lease automatic custody transfer
LDAR	Leak detection and repair
LNG	Liquefied natural gas
MBTA	Migratory Bird Treaty Act
mcf	Million cubic feet
MIS	Management Indicator Species
MOU	Memorandum of Understanding
mph	Miles per hour
MSDS	Material Safety Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
N_2O	Nitrous oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxide
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
O_3	Ozone
Pb	Lead
PBA	Programmatic Biological Assessment
PBO	Programmatic Biological Opinion
PILT	Payments in lieu of taxes
PFYC	Potential Fossil Yield Classification
PHMSA	Pipeline and Hazardous Material Safety Administration
PNG	Pawnee National Grasslands
PRRIP	Platte River Recovery and Implementation Plan

PSD	Prevention of Significant Deterioration
RGFO	Royal Gorge Field Office
RMBO	Rocky Mountain Bird Observatory
RMP	Resource Management Plan
ROD	Record of Decision
SCADA	Supervisory Control and Data Acquisition
SH	State Highway
SHPO	State Historic Preservation Office
SIA	Special Interest Area
SIO	Scenic Integrity Objective
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SPWRAP	South Platte Water Related Activities Program
SRL	Standard reach lateral
SSURGO	Soil Survey Geographic
T&E	Threatened and Endangered
TDS	Total dissolved solids
TL	Timing Limitation
TVD	True vertical depth
UIC	Underground injection control
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile organic compound
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WCR	Weld County Road

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CHAPTER 1 – INTRODUCTION

1.1 Identifying Information

CASE FILE/PROJECT NUMBER:	DOI-BLM-CO-F02-2014-052 EA
PROJECT TITLE:	Noble East Pony Oil and Natural Gas Development Project
PLANNING UNIT:	
LEGAL DESCRIPTION:	Weld County, CO Township 9 N, Range 59 W, Sections 8-15 and 21-24 Township 9 N, Range 58 W, western half of Section 19
APPLICANT:	Noble Energy, Inc.

1.2 Introduction and Background

Background: The Royal Gorge Field Office (RGFO) of the Bureau of Land Management (BLM) has received a proposal to develop oil and natural gas resources from Noble Energy, Inc. (applicant). The BLM prepared this Environmental Assessment (EA) to analyze environmental impacts of the construction of well pads and associated infrastructure (including roads, pipelines, and centralized production facilities) needed to horizontally drill 89 oil wells from 14 new multi-well pads and one existing well pad from which multiple wells would be drilled. All of the wells would be drilled on private surface estate. Sixty-three wells would penetrate a combination of private and/or federal mineral estate and 26 wells would penetrate only private mineral estate. The proposed well pads and associated infrastructure are located in the northern part of Weld County in an area known to the applicant as East Pony (Figure 2-1). The federal mineral estate within the project boundary is leased and subject to oil and gas development.

1.3 Purpose and Need

BLM's Purpose and Need

The BLM's purpose for the action is to provide Noble the opportunity to develop their leases for the production of oil and gas. The Mineral Leasing Act of 1920, as amended, and the regulations and policies by which it is implemented recognize the right of lease holders to develop federal mineral resources to meet continuing needs and economic demands, so long as unnecessary or undue degradation is not incurred. This includes the right to build and maintain necessary improvements, subject to lease terms and conditions. The lessee has the right to use as much of the leased lands as is necessary to explore, develop, and dispose of the leased resource (43 Code of Federal Regulations [CFR] 3101.1-2), subject to lease terms, conditions, and stipulations.

The BLM's need for the action is to respond to the applicant's proposal (develop oil and gas resources on Federal Leases COC 71623, 70899, and 70902) while minimizing environmental impacts and preventing unnecessary or undue degradation of the land. Drilling and producing the subject wells would penetrate federal mineral estate, which is the federal nexus requiring the preparation of this EA. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that the BLM manage public lands on the basis of multiple use (43 United States Code [U.S.C.] § 1701(a) (7)). Minerals are identified as one of the principal uses of public lands in Section 103 of FLPMA (43 U.S.C. § 1702(c)). The FLPMA mandates that these uses be permitted in a manner that assures adequate protection of other resource values.

Noble's Purpose and Need

Noble's need for the project is to exercise its valid existing lease rights by drilling and developing the oil and natural gas wells underlying those federal leases. Noble's purpose for the project is to fully develop oil and natural gas resources from its leases, while minimizing or mitigating to the extent feasible the environmental impacts associated with such development. To meet this purpose, the Proposed Action includes using horizontal drilling from proposed well pads to the extent technically and economically feasible. Specific requirements include the expansion of the existing, and installation of new, infrastructure including multi-well pads, roads, pipelines, and consolidated supporting facilities such as tanks, dehydrators, and compressors.

1.4 Decision to be Made

The BLM would decide whether, and under what terms and conditions, to approve the Proposed Action based on the analysis contained in this EA. This EA would analyze the construction of well pads, associated centralized production facilities, access roads, pipelines, and drilling a total of 89 horizontal oil wells; 63 new wells would penetrate a combination of private and/or federal mineral estate, and 26 new wells would penetrate only private mineral estate. BLM's authority extends to the 63 wells penetrating a combination of private and/or federal mineral estate, which would produce federal minerals on private surface estate and the associated facilities for those wells. Access to the proposed well pads would be primarily on existing county and rural roads, with short access roads to each of the well pad sites. Refer to Chapter 2 for more detailed information about the Proposed Action.

This EA addresses the potential effects of anticipated construction, operation, abandonment, and removal of all wells and other facilities associated with oil and gas exploration. The subsequent Applications for Permit to Drill (APDs) submitted for this development will reference this EA.

1.5 Plan Conformance Review

PLAN CONFORMANCE REVIEW: The Proposed Action is subject to and has been reviewed for conformance with following plan (43 CFR 1610.5, BLM 1617.3):

> **Name of Plan:** Northeast Resource Area Plan and Record of Decision as amended by the Colorado Oil and Gas Final Environmental Impact Statement (EIS) and ROD
>
> **Date Approved:** 09/16/86 amended 12/06/91
>
> **Decision Number:** O&G Resources, Issue 21
>
> **Decision Language:** "These 210,410 acres of surface and subsurface may be leased and developed for oil and gas with the standard stipulations included in the leases and standard site-specific stipulations included in any use authorization."

1.6 Relationships to Statues, Regulations, or Other Plans

This EA has been prepared in accordance with National Environmental Policy Act (NEPA) and is in compliance with all applicable regulations and laws passed subsequent thereto, including the Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508), U.S. Department of the Interior (USDI) requirements contained in Department Manual 516, Environmental Quality (USDI 1980), guidelines listed in the BLM Manual Handbook, H-1790-1 (BLM 1988), and Guidelines for Assessing and Documenting Cumulative Impacts (BLM 1994). The proposed project would be consistent with other federal, state and local laws, rules and regulations, and Noble would procure any required permits or easements prior to the commencement of drilling operations and subsequent evaluation of the project's proposed wells.

Noble must also comply with federal, state, and local regulations. Table 1-1 provides a list of major permits, approvals, and authorized actions necessary to construct, operate, maintain, and abandon project facilities. This list is intended to provide an overview of the key regulatory requirements that would govern project implementation. Additional approvals, permits, and authorizing actions may be necessary as identified through the environmental review process.

Table 1-1. Major Federal, State, and Local Permits, Approvals, and Authorizing Actions for the Noble East Pony Project

Agency	Action	Authority
USDI, BLM	Responsible for NEPA compliance, including the issuance of applications for permit to drill (APDs)	NEPA; FLPMA; 43 CFR 3160, Onshore Oil and Gas Order No. 1 and 2
USDI, U.S. Fish and Wildlife Service (USFWS)	Coordination, consultation, and impact review on federally listed threatened and endangered species, eagles, and migratory birds	Fish and Wildlife Coordination Act of 1934, as amended 1946, 1958, 1977; Section 7 of Endangered Species Act of 1973; Migratory Bird Treaty Act of 1918, as amended; Bald and Golden Eagle Protection Act of 1940
CDPHE – Air Quality Division	Issuance of air quality permits to construct and operate	Clean Air Act; Colorado Department of Public Health and Environment, Air Quality Control Commission (Regulation 7, 5 CCR 1001-9)
Colorado State Historic Preservation Office (SHPO)	Coordination, consultation, and impact review on cultural resources for the EA	Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, 16 U.S.C. 570; W.S. 35-12-109(a)(xiii)(C)
Weld County	Issuance of oil and gas permits which includes the oil or gas well, pumps, heater-treaters, separators, meters, compressors, tank battery, and other equipment directly associated with a producing well, all of which must be connected and functional. Issuance of building permits for oil and gas production facilities, except for activities associated with the drilling and completion of the well.	Section 23-1-90 of the Weld County Code, *Oil and Gas Production Facilities (and structures)*
Weld County	Issuance of access permits, required for the construction of any new access to a County road, or when the use of an existing access is changed.	Section 12-2-10 of the Weld County Code

1.7 Scoping, Public Involvement, and Issues

NEPA regulations (40 CFR §1500-1508) require that the BLM use a scoping process to identify potential significant issues in preparation for impact analysis. The goals of scoping are to identify issues and determine the scope of analysis for those issues.

Persons/Public/Agencies Consulted: The federal mineral estate parcels being accessed with this action were scoped and made available for public comment during the leasing process.

Public Scoping: Scoping for the EA began on January 7, 2015 when the BLM prepared and issued a press release announcing the initiation of the public scoping period and published the Proposed Action on its website. The BLM received four letters in response to public scoping for the Proposed Action. The Colorado Oil and Gas Association, Morgan County Economic Development Corporation, and the Western Energy Alliance all offered support to Noble's proposal and urged the BLM to process and approve the Proposed Action in a timely manner. The letter from Wild Earth Guardians identified a number of resource issues and encouraged the BLM to protect resources in the RGFO. Appendix A summarizes the issues identified by public comments, as well as by the Interdisciplinary Team (ID Team); this EA addresses these identified issues.

Agency Scoping: An ID Team meeting was held on December 15, 2014. The ID Team reviewed the Proposed Action, determined issues of concern for multiple resources, and determined which resources required assessment in this EA. The ID Team checklist summarizes the results of the internal scoping and is included with this EA as Appendix A.

Issues Identified: Issues and concerns were identified during internal scoping and from comments received during public scoping. Public commenters were concerned about air quality, greenhouse gas emissions and climate change, water quality and quantity, and potential impacts to federally listed species as a result of water depletions to the South Platte River Basin. These and other resources that are present in the project area and have the potential to be affected are carried through detailed analysis in Chapter 3. This EA only addresses resources that are present in the project area.

Development of the Proposed Action: Noble developed the Proposed Action over the course of several months, proactively addressing potential resource concerns. The East Pony Project is proposed in an area with existing infrastructure and oil and gas development, which reduces the need for new construction. Additionally, Noble proposes to construct centralized production facilities (called EcoNodes) to consolidate equipment from multiple wells, which reduces surface disturbance, air emissions, water consumption, road infrastructure, and associated traffic. Noble's commitment to no bleed pneumatic valves as well as their commitment to recycle up to 40 percent of the water used in drilling and completions via their mobile water recycling program go beyond regulatory requirements. These design elements and the additional applicant committed measures included in Chapter 2 help to avoid or minimize impacts to resources within the project area.

CHAPTER 2 – PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction

This chapter provides a description of the Proposed Action and No Action Alternative. No additional action alternatives have been identified. This EA considers a No Action Alternative to provide a baseline for comparison of the impacts of the Proposed Action. The Proposed Action integrates the terms and conditions in the RGFO ROD (BLM 1986a).

2.2 Alternatives Analyzed in Detail

2.2.1 Proposed Action

Noble proposes to construct well pads and associated infrastructure (including roads, pipelines, and centralized production facilities) needed to horizontally drill 89 oil wells (63 federal and 26 fee wells) from 14 new multi-well pads and one existing well pad from which multiple wells would be drilled. The Project Area is located in Township 9 North, Range 59 West, Sections 8-15 and Sections 21-24 and Township 9 North, Range 58 West, the western half of Section 19 in the Denver Julesberg (DJ) Basin in northern Weld County, Colorado (Figure 2-1). The project is located within an area known to Noble as East Pony. The project area is comprised of 7,986 acres, of which approximately 80 percent is private surface and 20 percent is Pawnee National Grasslands (PNG) surface. Notably, this means that less than one percent of the 190,000 acre PNG is located within the project area. No surface disturbance is proposed on the PNG. The project area includes 7,986 acres of mineral estate, of which 2,082 acres are minerals administered by the Bureau of Land Management (BLM) and 5,904 acres are privately held minerals.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres (Table 2-1). Specifically, Noble's Proposed Action includes the following components as depicted in Figures 2-2 and 2-3 and described in Table 2-1.

- Horizontally drilling up to 89 new oil wells from 14 new multi-well pads and one existing well pad from which multiple wells would be drilled. The construction of the well pads would result in 121.2 acres of surface disturbance on private land.
- Development of four centralized processing facilities (EcoNodes) on private surface land resulting in 77.3 acres of surface disturbance on private land.
- Development of one water supply well on 1 acre to provide water for a portion of the project's water needs.
- Installation of 5.9 miles of buried pipelines resulting in 82.5 acres of total surface disturbance on private land including the following:
    - Installation of approximately 1.1 miles of buried water supply pipelines to collect and transport water from a proposed water supply well to two existing water storage ponds.
    - Installation of approximately 2.7 miles of flowlines to transport oil, natural gas, and produced water from the wellheads to the EcoNodes.

  - Installation of approximately 2.1 miles of new oil and natural gas gathering lines to transport product from the EcoNodes to existing oil and natural gas pipeline infrastructure.
- Installation of 5.6 miles of temporary surface water supply pipelines to transport water from the existing storage ponds or the existing buried water supply pipeline to the proposed oil and natural gas wells. No surface disturbance is associated with these lines.
- Construction of new roads and improvements to existing roads resulting in approximately 23.8 acres of total surface disturbance including the following:
  - Development of approximately 2.2 miles of new roads in Sections 22 and 24 to provide access to the project area, well pads, and EcoNodes resulting in 10.8 acres of surface disturbance in private land.
  - Development of approximately 1.9 miles of improvements to existing ranch/access roads in the project area resulting in 5.2 acres of surface disturbance in private land.
  - Development of approximately 4.3 miles of a pipeline maintenance two-track resulting in 7.8 acres of surface disturbance in private land.

Construction, drilling, and completion of the proposed wells would occur over a period of approximately two years.

Figure 2-1. Project Vicinity

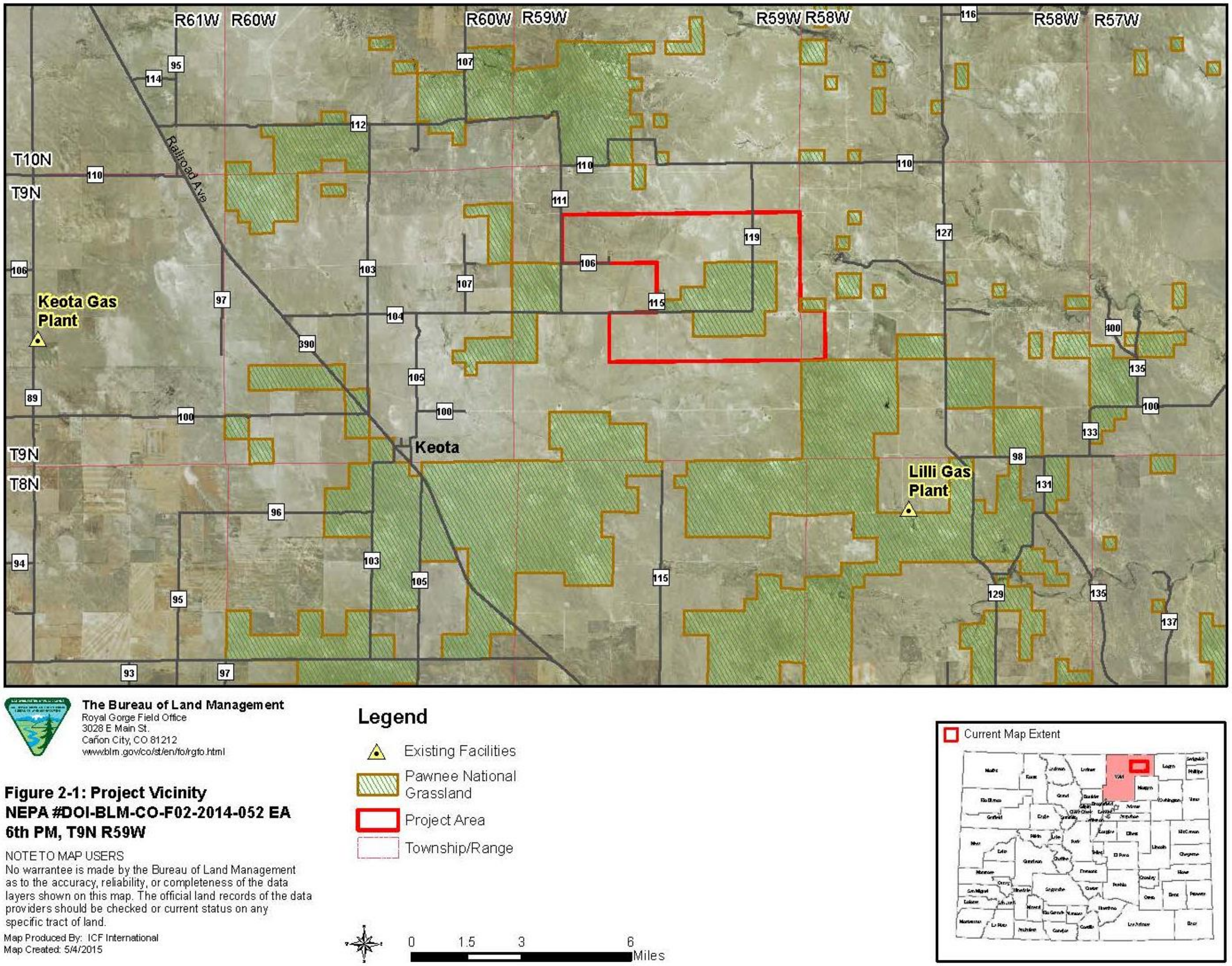


Figure 2-2. Proposed Action Map (with Aerial Background)

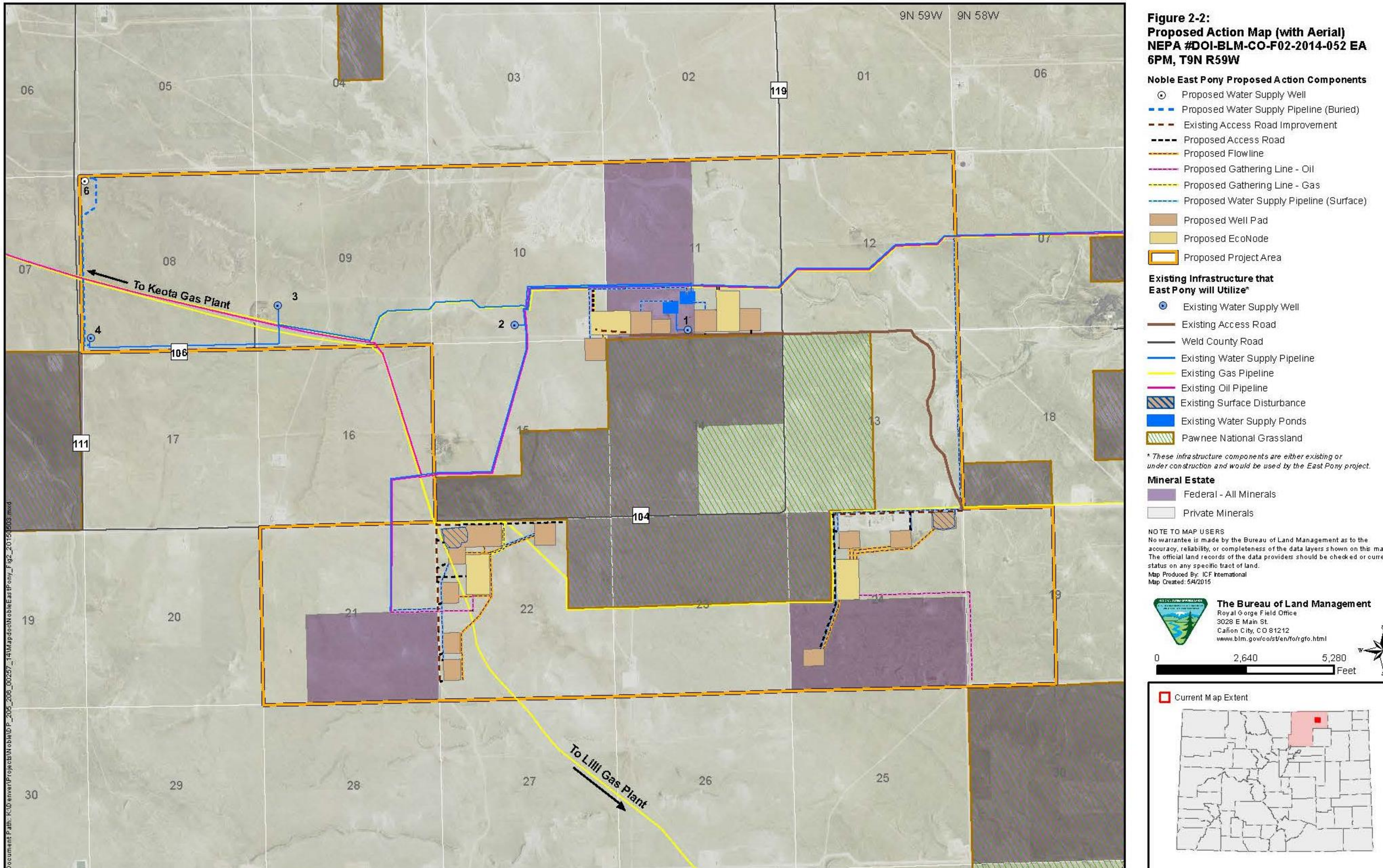
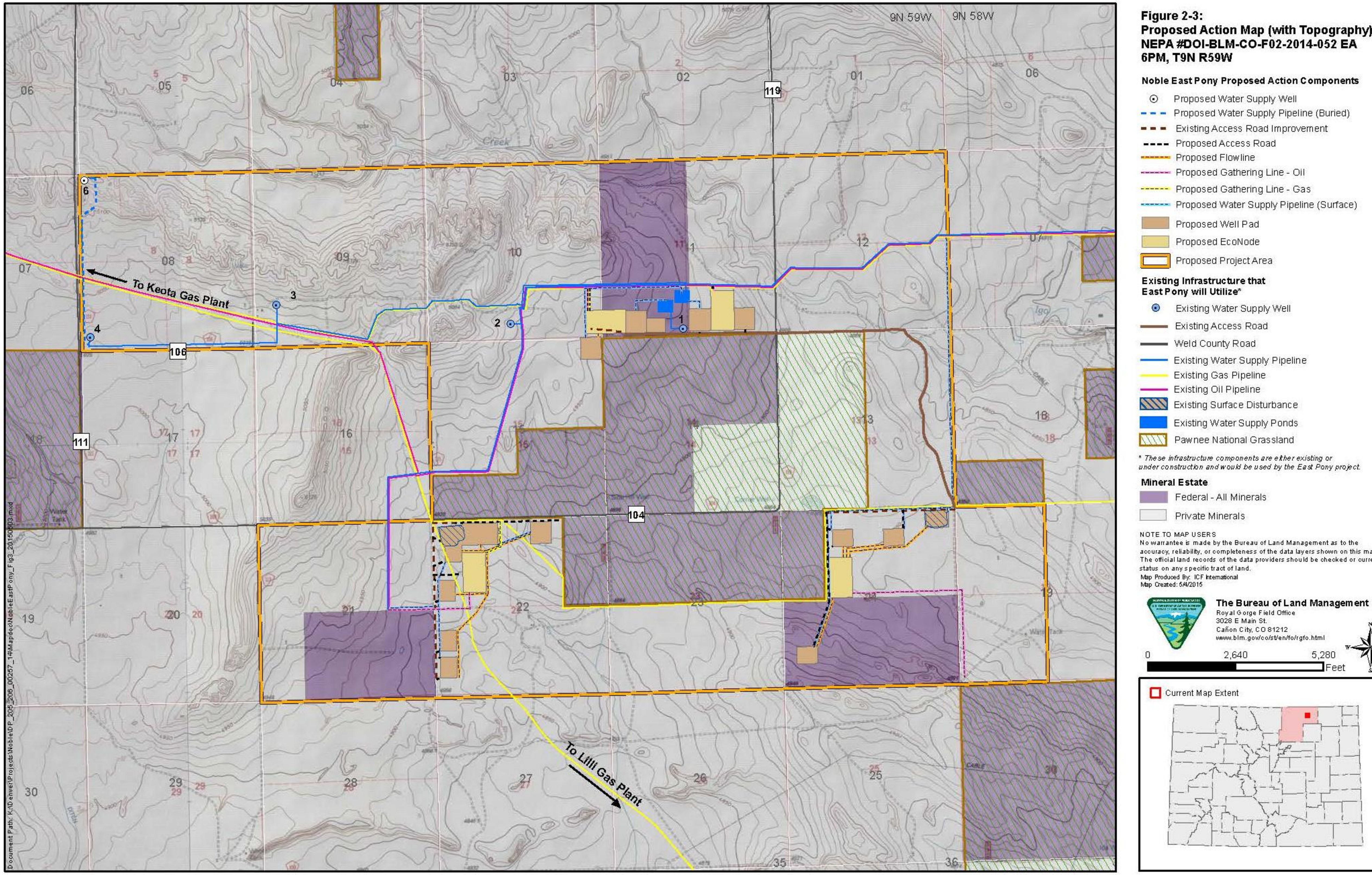


Figure 2-3. Proposed Action Map (with Topography)



Construction and drilling activities for each proposed well, associated well pad and infrastructure facility components would follow practices and procedures outlined in individual APDs that Noble would file in time for the BLM to approve soon after completion of this NEPA process (at the time of a Decision Record). Furthermore, Noble would comply with any APD-specific Conditions of Approval (COAs) identified by the BLM, as well as requirements of the private surface landowner.

Table 2-1. Summary of Surface Disturbance from the Proposed Action

Project Elements	Initial Surface Disturbance (acres)	Permanent Surface Disturbance (acres)
Oil and Natural Gas Well Pads		
Beretta Federal LC24-03	7.3	2.6
Browning Federal LC24-13	7.3	2.5
Constitution Federal LC21-05	7.3	2.6
Dukes and Hazzard Federal LC22-02	9.4	4.4
Wyatt and Earp Federal LC11-16	10.0	4.4
Freedom Federal LC22-12	7.3	2.6
Doc and Holliday Federal LC11-13	9.8	4.7
Kramer Federal LC15-01	9.4	3.5
Magpul Federal LC22-04 (two well pads located adjacent to each other)	22.6	7.9 (east) 2.7 (west)
Minutemen Federal LC22-13	7.3	2.3
Remington Federal LC24-02	7.3	2.5
Johnny and Ringo Federal LC11-16	9.4	4.0
Tombstone Federal LC11-13	5.5	2.4
Winchester Federal LC24-01 (existing pad to be expanded)	1.3	0
Subtotal	***121.2***	***49.1***
Water Supply Well Pad		
Section 8 well (well #6 on map)	1.0	0.5
EcoNodes		
LC11-13 Production Facility	19.4	19.4
LC11-15 Production Facility	19.3	19.3
LC22 Production Facility	19.3	19.3
LC24-6 Production Facility	19.3	19.3
Subtotal	***77.3***	***77.3***

Table 2-1. Summary of Surface Disturbance from the Proposed Action

Project Elements	Initial Surface Disturbance (acres)	Permanent Surface Disturbance (acres)
Buried Pipelines		
Three-phase flowlines[2]	32.3	0.0
Oil Gathering Lines (up to 16-inch steel)[3]	30.4	0.0
Natural Gas Gathering Lines (8-inch steel)[3]	4.4	0.0
Oil and Natural Gas Gathering Line (Collocated)[3,4]	2.6	0.0
Water Supply Pipeline (16 - 24-inch poly)	13.2	0.0
Subtotal	***82.5***	***0.0***
Pipeline Maintenance Two-Track		
Pipeline Maintenance Two-Track (15-foot)	7.8	7.8
Temporary Surface Pipelines		
Temporary, Lay-Flat Water Supply Water Pipelines (12 - 14-inch lay-flat lines) (no associated surface disturbance)	0.0	0.0
Access Roads		
Proposed Roads[1]	10.8	5.4
Existing Road Improvements[5]	5.2	1.0
Subtotal	***16.0***	***6.4***
TOTAL	***305.2***	***140.6***

Source: Noble 2014

[1]Assumes maximum 100-foot construction right-of-way for flowlines and buried water supply pipelines.
[2]Assumes maximum 150-foot construction right-of-way for oil and natural gas gathering lines.
[3]The oil and natural gas gathering lines associated with each well pad would be buried in the same disturbance corridor. The length (feet) represents the total combined length of the pipelines.
[4]Assumes maximum 40-foot right-of-way for all proposed roads, and a 30-foot running surface. Proposed roads would be reclaimed back to a 15-foot running width following completion operations.
[5]Existing roads would be improved to a running width of 30 feet to accommodate larger vehicles and equipment. Improved existing roads would be reclaimed back to a 15-foot running surface following completion operations.

2.2.1.1 Well Pad Construction

Well pad construction would entail the use of crawler tractors, motor graders, Class 125 or larger track hoes, backhoes, 10- to 20-yard dump trucks, and Class 988 loaders. Within the approved well pad location, a crawler tractor would strip whatever topsoil is present and stockpile it along the edge of the well pad for use during reclamation. Noble would use erosion control measures as necessary, including proper grading to minimize slopes, diversion terraces and ditches, mulching, terracing, riprap, fiber matting, temporary sediment traps, and broad-based drainage dips or low water crossings to minimize erosion and surface runoff during well pad construction and operation. Construction activities would comply with all applicable stormwater control requirements.

The layout of a typical multi-well pad is shown in Appendix B. As previously stated, each well pad would host between three and 12 wells. For analysis purposes, it is assumed that each multi-well pad would host an average of six wells.

2.2.1.2 Access Roads

The Proposed Action would include the construction of new access roads, and the improvement of existing access roads. Construction of new access roads would require an initial disturbance width of approximately 40 feet, with a running surface width of 30 feet. None of the proposed access roads would cross navigable waterways or wetlands. The Proposed Action would also require upgrades (i.e., widening) of approximately 1.9 miles of existing roads within the project area. Due to the varying conditions of existing roads, upgrades to existing roads would also vary. Existing 15-foot roads would be widened to a 30-foot running surface (40-foot disturbance corridor) to facilitate the passage of project equipment. Following completion operations, new and existing improved roads would be reclaimed back to a running width of 15 feet. All roads within the project area would have a design speed of 20 miles per hour (mph).

Construction of all new and upgraded roads would follow Weld County standards. New road construction and improvements of existing roads would typically employ motor graders, crawler tractors, 10-yard end dump trucks, and water trucks. The standard methodology for building new roads involves the use of a crawler tractor or track hoe to windrow the vegetation to one side of the construction corridor, remove topsoil to the opposing side of the construction corridor, and rough-in the roadway. This is followed by a grader or bulldozer to establish barrow ditches and crown the road surface. Where culverts are required, a track hoe or backhoe would trench the road and install the properly-sized culverts using good engineering practices. Some hand labor would likely be used when installing and armoring culverts.

Timing of road construction and improvements would depend largely on the drilling schedule and weather conditions.

2.2.1.3 Drilling

Once construction of a multi-well pad is complete (approximately eight days) the drilling rig would be moved onto the pad. Noble proposes to use dual-fuel drill rig engines (i.e., engines that can be fueled by liquefied natural gas [LNG] or diesel) that would be fueled by LNG and would meet 40 CFR Part 60 Subpart JJJJ. Noble anticipates that up to four drilling rigs would operate in the project area at any one time. Each well would take on average 10 days to drill.

The surface-hole locations for horizontal wells would be located 200 to 300 feet from the perimeter of the geographic section line to allow for optimal development and drainage. The specific well pad and drilling locations would vary within each section based on geologic and surface characteristics and constraints, as well as the properties of the formation being drilled.

Well heads would be spaced 37.5 feet apart from each other on the multi-well pads. All the wells on a well pad would be drilled using a single skid-mounted rig that is mobilized and demobilized once per well pad.

The proposed wells would typically target the Niobrara Formation but Noble may drill into other formations based on the results of reservoir testing in other areas of the DJ Basin. The average depth of each well would be approximately 6,500 feet true vertical depth (TVD). Noble would drill a combination of Standard Reach Lateral (SRL) wells and Extended Reach Lateral (ERL) wells. SRLs would be horizontally drilled to a lateral distance of approximately 4,000 feet. ERLs would be horizontally drilled to a lateral distance of approximately 9,000 feet.

All wellbores would be cased and cemented as part of the drilling effort and would be tested for integrity prior to well completion operations. Casing setting depths are determined by several factors, including: presence/absence of hydrocarbons, fracture gradients, usable water zones, formation pressures, lost circulation zones, other minerals, or other unusual characteristics In addition, a 16-inch diameter conductor pipe is set to depth of 100 feet for surface soil stabilization and will provide a base for the surface casing wellhead. During production additional production tubing is set from the surface to the liner top. Each layer of casing and the depth from the surface at which it is set provides specific functions and protections for the well completion including: stabilization of the hole, isolation and protection of aquifers and groundwater resources, prevention of blowouts, and preparation of the well for production. In addition, smaller diameter production tubing is generally used within the casing to more effectively produce oil and natural gas.

Each individual federal well will have a drilling plan submitted with the BLM APD. The drilling plans will be reviewed by the BLM petroleum engineer to ensure compliance with BLM Onshore Order #2, which specifies casing and cementing requirements to protect usable groundwater and other usable mineral zones. The BLM engineer may attach site specific COAs to the APD, if necessary. Figure 2-4 depicts proposed well bore trajectories. This is the best information available at this time and is subject to change.

Noble would use a closed-loop system for managing fluids, therefore, no reserve pits are needed. Noble would use water-based drilling mud fluid during its drilling. Noble would not fence any of the proposed facilities or pads.

2.2.1.4 Well Completion and Workovers

Once a well has been drilled and cased, completion operations would begin. In conjunction with these completion operations, Noble would hydraulically fracture selected intervals within the targeted formation in order to “stimulate” production. In Colorado, hydraulic fracturing is regulated by the Colorado Oil and Gas Conservation Commission (COGCC). Some of these requirements require operators to mitigate all existing wells within 1,500 feet of the proposed well that penetrates the formation to be hydraulically fractured to be investigated and mitigated to prevent possible fluid migration up the wellbore, checks to ensure wellbore integrity, and public disclosure of hydraulic fracturing fluid ingredients. These hydraulic fracturing operations typically include the pumping of a thick fluid mixture, consisting of 13 percent sand, 86 percent water, and a small concentration of other constituents, down the bore hole to the target area under pressure. Various chemical additives are added to the fracturing fluids to improve performance. The mixture is then pumped in a series of stages through the perforations, or ports, into the formation. A typical well has about 24 stages, and in the DJB the hydraulic fracturing process can take up to 36 hours. As the formation is fractured, the resultant fissures (fractures) are filled with sand, which props them open and facilitates the flow of oil and natural gas. The chemicals, some of which are commonly found in food processing and household cleaners, are used for a variety of purposes such as controlling the growth of bacteria that could corrode the casing in the wellbore and altering the viscosity of the fluid to enhance sand carrying capability of the water into the fractures. As required by the COGCC, Noble submits the contents of the fracturing fluid used to FracFocus.org, a national hydraulic fracturing chemical disclosure registry managed by the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission. For additional information on hydraulic fracturing, including a list of Noble’s hydraulically fractured wells, please visit the national hydraulic fracturing chemical registry at FracFocus.org.

Based on Noble’s experience with the technology, the fractures extend laterally out and stay within the target formations. Hydraulic fracturing is done in stages along the horizontal portion of the well. Each stage is completed before the next stage begins. All other areas of the horizontal well are closed off during hydraulic fracturing.

Hydraulic fracturing would typically be completed at a target depth of 6,500 feet true vertical depth, in the Niobrara or Codell Formations. The deepest known potable aquifer is the Laramie Fox Hills aquifer, which in this area extends to a depth of approximately 500 feet below ground surface. Noble will comply with COGCC and applicable BLM rules governing casing requirements to protect drinking water sources, such as the Laramie Fox Hills aquifer. The Pierre Shale Formation underlies the Laramie Fox Hills, and is a well-known confining formation. The Pierre Shale and other confining layers are present within the 6,000 feet of separation between the Laramie Fox Hills aquifer and the target formation.

Given the distance and geologic separation between the target formation (the Niobrara) and the lowest known drinking water aquifer (the Laramie Fox Hills), and adherence to regulations, there would be no connection between the hydraulic fractures and any known potable aquifers. Once hydraulic fracturing is complete, the well is allowed to “flowback.” The flowback procedure allows a portion of the hydraulic fracturing liquid to return to the surface where it is collected in closed tanks. This is part of the “Green Completion” process that Noble follows for flowback operations, pursuant to all applicable federal and state regulations. Noble’s green completion techniques are methods that minimize the amount of natural gas and oil vapors that are released to the environment when a well is being flowed during the completion phase of a well. The flowback or test phase is completed once measurable amounts of hydrocarbons are detected from the well. The flowback procedure in the project area usually takes 1 to 2 days. Of the estimated 1,200 ac-ft of water to be used in completion operations, approximately 40 percent (i.e., 480 ac-ft) would return to the surface as water byproducts. Noble anticipates that they would be able to recycle and re-use up to half of that (i.e., approximately 240 ac-ft).

On average, the entire completion process takes approximately seven days per well.

Occasionally during the life of a well, workovers are needed. A workover is a downhole oil well maintenance operation involving the removal and replacement of the production tubing typically using a wireline or coiled tubing truck. Specifically, it refers to the process of recompleting a well. It may be similar to the original completion, but it is often less involved. The goal of the workover is to improve production from the well. The type and frequency of the workover depends on factors such as well production, reservoir rock characteristics, and age of the well. In general, a workover may be carried out every few years, with more intensive workovers, which may include hydraulic fracturing, typically occurring only once or twice during the life of the well.

2.2.1.5 Central Production Facilities (EcoNodes)

Individual wells in the field would be tied into the EcoNodes, which are locations containing field gathering points where production is metered and the natural gas is separated from the liquids before being transferred to the existing gathering system. Construction methodology would be similar to that described for well pads. Each EcoNode is designed to serve multiple well pads and their associated wells. The layout of a typical EcoNode is shown in Appendix B.

The Proposed Action includes the construction of four new EcoNodes. In this proposal, each EcoNode would accommodate production from between 16 and 37 wells (Figures 2-2 and 2-3). Typical equipment on an EcoNode may include sand catchers, separators, oil production tanks, produced water tanks, gas lift compressors[1], maintenance tanks, line heaters, water tanks, vapor recovery systems,

[1] *After several years of production gas lift compressors would be removed from the EcoNode and pump jacks would be installed at the well head, which would have lower emissions than the compressors. However, the emissions inventory for this project conservatively assumes that gas lift compressors would operate for the life of the project.*

flares and vapor combustion units, allocation and sales meters, lease automatic custody transfer (LACTs), and miscellaneous piping. The number of tanks and other production equipment on an individual EcoNode would depend on the number of wells that EcoNode is serving. However, on average there would be 39 oil tanks and 26 produced water tanks on each EcoNode. Each EcoNode would be approximately 20 acres in size.

2.2.1.6 Pipelines

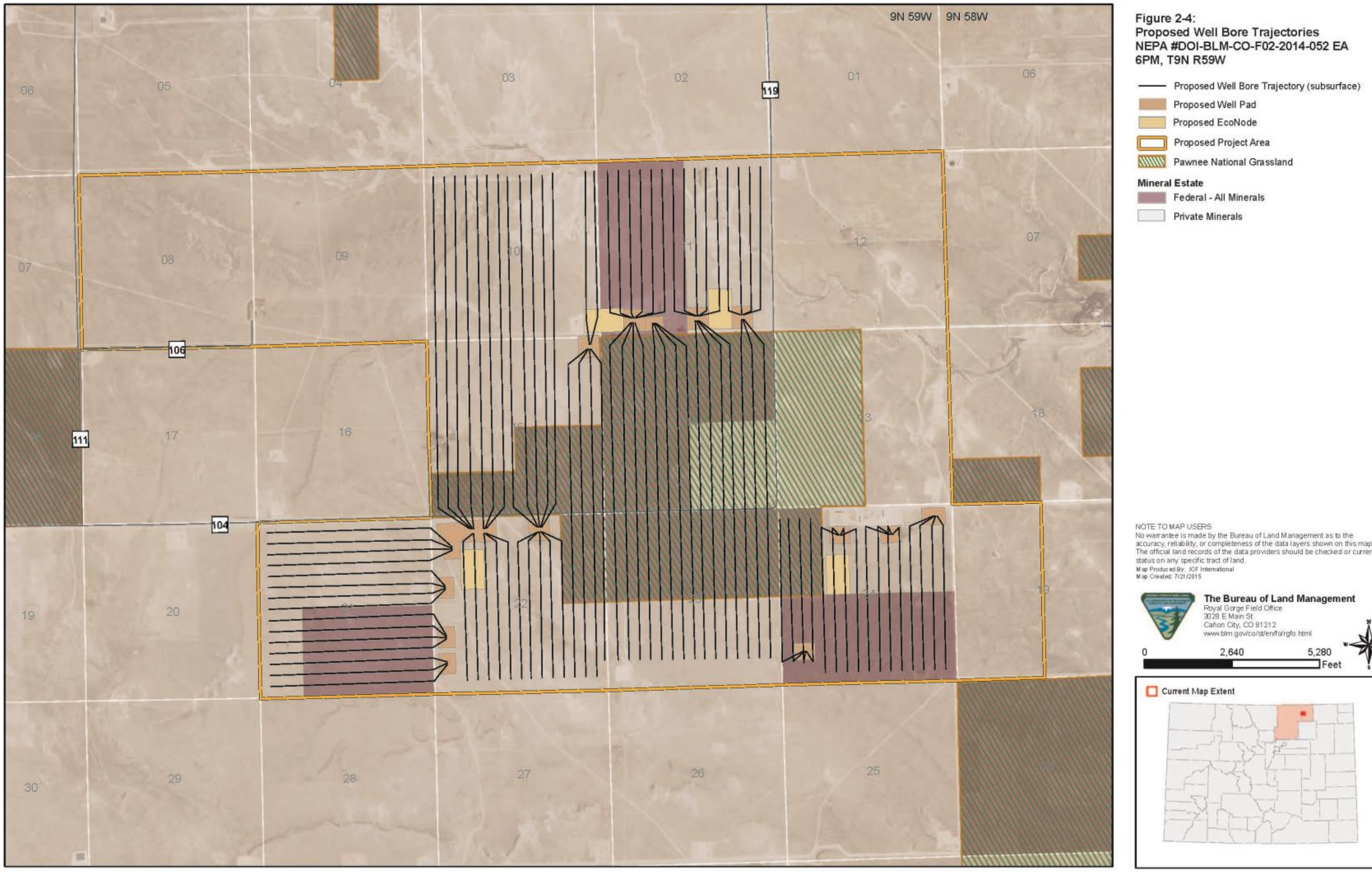
The Proposed Action would use an existing network of water supply lines, oil, and natural gas pipelines (Figures 2-2 and 2-3). In this Proposed Action, the term pipelines and lines are used interchangeably. Noble proposes to develop additional pipelines to facilitate transportation of water, oil, and natural gas throughout the project area and connect the proposed project elements to the existing infrastructure.

Noble proposes a 100-foot temporary pipeline construction corridor for the buried water pipelines and flowlines and a 150-foot temporary pipeline construction corridor for buried oil and natural gas gathering lines (Figures 2-2 and 2-3). This area would accommodate vehicle access, staging areas, and excavating equipment. Oil, natural gas, and water pipelines would be co-located if feasible. All proposed buried pipelines would be fully reclaimed to the specifications of the surface landowner. A 15-foot wide corridor would be maintained along the length of buried pipeline corridors to accommodate a two-track road for potential operations and repairs on buried pipelines.

Buried pipelines would be installed using the following general construction sequence:

- A brush-hog would be used to remove shrubs and small trees from the construction corridor. Topsoil removal would not occur except directly over the trench.
- As feasible, stockpiled topsoil would be placed over the compacted soil on the non-working side of the pipeline construction corridor to facilitate reclamation. However, for fire mitigation purposes, stockpiled topsoil could potentially be stored off the construction corridor, at a distance of no more than 30 feet from the construction corridor.
- A trench would be excavated using a grader to excavate topsoil, followed by a trencher or excavator to deepen the trench to approximately 4 feet deep. The pipeline would be installed using a side-boom, the trench backfilled, and the spoil compacted in the trench using a grader.

Figure 2-4. Proposed Well Bore Trajectories



The proposed pipelines would be designed, constructed, and tested per all applicable COGCC and Colorado Department of Transportation (CDOT) regulations, which would include visual, radiographic, and/or hydrostatic testing before being placed into service. This procedure is designed to test the pipeline integrity pursuant to all applicable DOT guidelines. Noble anticipates needing less than 1 ac-ft of water to conduct hydrostatic testing. Table 2-3 identifies the proposed water sources from which Noble would acquire the water used for hydrostatic testing. Hydrostatic testing water would either be disposed of at a permitted facility or broadcast onsite under an approved permit from the Colorado Department of Public Health and Environment (CDPHE).

Pipeline installation and operation would be conducted in compliance with applicable stormwater, spill prevention, and health and safety requirements, and in accordance with applicable Pipeline and Hazardous Materials Safety Administration (PHMSA) and other CDOT requirements. Pipeline markers would be strategically placed at intervals along all buried and surface pipelines. Noble would install above-ground block valves at sensitive locations, and per applicable regulations, would install cathodic protection along steel pipelines for pipeline integrity and safety purposes. During operation of pipelines, Noble would monitor the pipeline system in accordance with all applicable regulations and Noble's own operating practices. In addition, Noble would install pipeline signs along the route to indicate the pipeline's proximity and ownership and to provide emergency contact phone numbers.

The following sections provide a description of each type of proposed pipeline.

Buried, 16 to 24-inch Poly Water Supply Pipelines

Figures 2-2 and 2-3 show a proposed high-density polyethylene (HDPE or poly) water supply pipeline (approximately 0.9 mile in length) connecting proposed water supply well #6 to the existing water supply pipeline that carries water from the existing water supply wells to the existing, two water storage ponds. See Section 2.2.1.8 Flowback and Produced Water Management and Disposal for further discussion on water use, storage, and transport. The proposed water supply pipeline would be 16 to 24 inches in diameter.

Temporary, Surface-laid, 12-14-inch "Lay-Flat" Water Supply Pipelines

Figures 2-2 and 2-3 also show temporary water supply pipelines that would bring water to the oil and natural gas wells, from the existing storage ponds. These temporary, "lay-flat" lines are similar to fire hoses. Proposed surface-laid water supply lines would be spooled from the back of a light weight truck. No vegetation removal is proposed for installation of the surface water lines. However, temporary compression of vegetation and soils could occur as a result of the truck used for installation. Surface water lines would be removed within 60 days of termination of use on each well pad.

Buried, 3-inch Steel Three-phase Flowlines

Noble proposes to install flowlines to transport produced water, oil, and natural gas from each of the wells on the well pad to the EcoNodes, where three-phase separation occurs. The proposed action includes a network of approximately 2.7 miles of proposed flowlines.

Buried, 8-inch Steel Oil Gathering Lines

From the EcoNodes, 8-inch diameter steel oil gathering lines would be installed to carry oil to existing oil pipelines in the project area that would then carry oil either northwest to the SemGroup pipeline or south to the Tallgrass Northeast Colorado Lateral (Figures 2-2 and 2-3), both of which have capacity for oil transport under this project. Under the Proposed Action, all oil would be transported via pipeline.

Buried, 16-inch Steel Gas Gathering Lines

Once the gas is separated out at the EcoNodes, up to 16-inch diameter steel natural gas gathering lines would transport the natural gas from the EcoNodes into the existing gathering systems in and around the project area (Figures 2-2 and 2-3), which have capacity to support natural gas gathering under this project. Natural gas would flow into the existing gathering system that feeds the Lilli Gas Plant, Keota Gas Plant, and other existing third-party processing plants. At some future time, it is also possible that natural gas could flow into gas plants that do not yet exist. Compression needs for natural gas would include up to six 1,380 horsepower (hp) compressor engines at each EcoNode. However, high-pressure lines are not anticipated. As with any combustion equipment used in conjunction with this Proposed Action, Noble would obtain all applicable permits in a timely manner and comply with their conditions and limitations, including air quality preconstruction and operating permits.

2.2.1.7 Water Supply

Based on the total number of proposed wells, Noble anticipates needing up to approximately 1,245 acre-feet (ac-ft) of water for the project from construction through production that would be served through an independent water supply and management system.

Based on previous experience with wells drilled in the area, Noble estimates that drilling would require approximately 42 ac-ft of water. Completion would require approximately 1,200 ac-ft of water total. In addition to water for drilling and completion operations, approximately 2 ac-ft of water would be necessary for dust abatement and less than 1 ac-ft of water would be used for hydrostatic testing of new pipelines. Table 2-2 details the estimated water volumes necessary for the proposed project.

Table 2-2. Water Volumes for the Proposed Action

Project Phase	Total (acre-feet)
Drilling	42
Completion	1,200
Dust Abatement	2
Hydrostatic Testing	<1
TOTAL	**1,245**

Source: Noble 2014

N/A Not applicable

Noble would use four existing and one proposed, private water supply wells to support the Proposed Action. No surface water from within the project area would be used. Tests from the existing wells completed in the Upper Pierre Formation indicate the water is not potable due to levels of sulfate and chloride that do not meet the EPA's recommended levels for potable water, as well bicarbonate, total dissolved solids (TDS), and some metals (eAnalytics Laboratories 2013) present in the water. Table 2-3 identifies the water sources that may be used for the Proposed Action.

Table 2-3. Water Sources That May Be Used for the Proposed Action

Well #	Status	Water Permit Number	Source	Location
#1	Existing	78058	Upper Pierre Formation	SE1/4 SW1/4 S11 T9N R59W
#2	Existing	77932	Upper Pierre Formation	SE1/4 SW1/4 S10 T9N R59W
#3	Existing	296103	Laramie-Fox and Upper Pierre Formation	SW1/4 SW1/4 S9 T9N R59W
#4	Existing	296104	Laramie-Fox and Upper Pierre Formation	SW1/4 SW1/4 S8 T9N R59W
#6	Proposed	Not Yet Applied For	Laramie-Fox and Upper Pierre Formation	NW1/4 NW ¼ S8 T9N R59W

Source: Noble 2014

Note: Noble also applied to the State for a water supply well #5. However, they do not anticipate needing water from the #5 well for this project and therefore do not propose to drill it as part of this project.

Water from the four existing private water wells is currently transported via existing buried pipeline to two existing water storage ponds that are each 3.75 surface acres in size in Section 11. Water from the proposed water supply well would be transported through a 0.9-mile long segment of proposed pipeline that would connect to the existing water supply pipeline in the SW¼SW¼of Section 8, and then be transported to the storage ponds. The existing water storage ponds (Figures 2-2 and 2-3) are lined and fenced to prevent entry by wildlife, livestock, or the public. Surface-laid water supply lines would then deliver water from the existing storage ponds to the well pads for drilling and completion operations (Figures 2-2 and 2-3).

2.2.1.8 Flowback and Produced Water Management and Disposal

Flowback

Upon completion of the hydraulic fracturing operation, much of the flowback water produced from the oil and natural gas wells would flow back to the surface and be captured in enclosed, covered, or netted and screened temporary on-site storage tanks.

Water Reuse

Of the 1,200 ac-ft of water to be used in completion operations, approximately 40 percent (480 ac-ft) would return to the surface as water byproducts. Noble anticipates that they would be able to recycle and re-use up to half of that (i.e., 240 ac-ft). To accomplish this, Noble proposes a recycling program to capture, treat, and reuse water byproducts in subsequent hydraulic fracturing operations. Noble has successfully used a mobile reverse osmosis system (mobile water treatment unit) to accomplish water treatment for other development near the project area. Each mobile unit has a capacity of about 3,400 barrels per day. Up to two mobile units would be used to serve the project area.

Each mobile water treatment unit setup typically occupies an area less than 0.5 acre and would be located on the new well pads, which would result in no additional surface disturbance. Although the layout can vary, the components of a mobile water treatment unit typically include one office trailer, three equipment trailers, and enclosed water storage tanks, which would be temporarily set up on an existing pad.

As mentioned, water byproducts would be captured at the wellhead, stored on-site at the well pad, and transported via temporary, lay-flat lines as influent to the mobile water treatment units. The influent water would then be treated through a three-phase treatment process in a closed system. Treated water would then be piped (again via surface line) to nearby well pads for re-use in subsequent hydraulic fracturing operations. Solid byproducts would be dewatered and transported to a nearby, permitted landfill. The excess flowback water that is not reused will be transported offsite for disposal in permitted third-party UIC wells.

Produced Water Disposal

Excess water byproducts that are not recycled would be transported via buried pipeline (three-phase flowline) to an EcoNode, stored temporarily in tanks, transferred to 150-barrel trucks, and transported off-site by a professional disposal service to one of the following two COGCC permitted underground injection control (UIC) wells managed by a third party, both of which have the capacity to receive the anticipated volume of disposal water associated with this project:

- Conquest SWD C8A in T11N, R62W
- Conquest SWD C7A in T7N, R63W

In the future, if additional permitted UIC wells are developed in closer proximity to the project area, Noble would potentially use those to further minimize truck traffic within the project area.

2.2.1.9 Wastes, Solid or Hazardous

Garbage would be collected in portable, self-contained, fully enclosed dumpsters or trash cages. Upon completion of operations, or as needed, the contents would be hauled off to an approved landfill. Portable, self-contained chemical toilets would be provided for human waste disposal. The tanks would be pumped and the contents disposed of in accordance with CDPHE rules and regulations.

Noble would manage wastes generated during drilling and production operations in accordance with applicable COGCC and CDPHE regulations. Wastes that are generated during drilling and production operations typically include drill cuttings, spent drilling muds, produced water, and flowback fluids and flowback sand from hydraulic fracturing operations, spent filters, pipeline pigging wastes, tank bottoms and soils or debris generated from cleanup of spills or releases. While on site, these wastes would be managed in tanks, containers, or roll-off containers. In addition, more common industrial waste streams such as used oil, paint wastes, and general trash/debris would be generated. Pursuant to Rule 907.d(3) A of "Rules and Regulations," as established April 1, 2009 by the COGCC, all exploration and production (E&P) wastes that are not recycled would be transported off location and transported to a permitted disposal site.

Hydraulic fracturing requires water or recycled water and results in the flow of water and hydrocarbons from the well into temporary, 500-barrel storage tanks. Generally the fluid used during coil tubing cleanout is water and in some cases nitrogen. The volume of water used during coiled tubing operations is a fraction of what is used during the stimulation operations. These fluids are recycled, sold, or disposed of offsite at a COGCC approved facility.

2.2.1.10 Reclamation

Interim Reclamation

During well pad construction, topsoil would be removed and stockpiled for reclamation. Sufficient topsoil to facilitate revegetation would be segregated from subsoil materials during construction activities and stockpiled for future reclamation of the disturbed areas. Topsoil stockpiles would be stabilized with vegetation until used for reclamation purposes as necessary or required by either the private surface owner or the BLM. Following completion of construction activities, all disturbed areas not required for production operations would be reclaimed in accordance with guidance from the private surface landowner. As technically and economically feasible, and as approved by the private surface landowner, reclamation and weed control would be conducted in accordance with the guidelines included in the Colorado Parks and Wildlife's (CPW) [formerly Colorado Division of Wildlife (CDOW)] Actions to Minimize Adverse Impacts to Wildlife Resources, dated October 27, 2008 and updated March 16, 2012 (CDOW 2008).

The salvaged topsoil would be evenly distributed over those disturbed surfaces subject to interim reclamation upon termination of drilling and completion operations. Interim reclamation would entail backfilling, leveling, re-contouring, and seeding of areas not needed for production activities. Disturbed surfaces at the well pads not needed for production would be reclaimed as soon as practicable after the initial disturbance. If approved by the private surface landowner, pipeline construction corridor disturbance areas would be completely reseeded as soon as practicable in the next appropriate seeding season. Seed mixes for interim reclamation would be developed in coordination with the private surface landowner.

Well Plugging, Abandonment, and Final Reclamation

Once a well has reached the end of productive life, the well would be plugged, capped, and all surface equipment would be removed. Typically, underground pipelines would be cleaned out, plugged at specified intervals, and abandoned in place to reduce surface disturbance. Upon final abandonment of the wells at the end of their production life, all facilities and surfacing materials would be removed and all road and pad areas would be re-contoured and reseeded. Roads could remain at the request of the surface landowner. The wells would also be plugged and abandoned per COGCC and BLM regulations.

Earthwork for final reclamation would be completed within six months of well plugging activities for all wells on a multi-well pad (weather permitting). All well pads and roads would be reclaimed in accordance with the reclamation plan provided as part of the APDs. The site would be revegetated to a safe and stable condition unless an agreement is made with the landowner or surface managing agency to keep the road or pad in place.

2.2.1.11 Design Mitigation Features

Noble must comply with all federal, state, and local regulations. Noble would also adhere to industry best management practices (BMPs) during construction and operation of the Proposed Action. In addition to existing requirements and BMPs, Noble proposes various measures to avoid, minimize, and/or mitigate impacts to resources from implementation of the project which have been incorporated into the Proposed Action. Chapter 3 of this EA analyzes the Proposed Action with these measures applied.

Air Quality

- Existing and proposed access roads within the project area would have a design speed of 20 miles per hour.
- Noble's standard operating practices with Weld County and private landowner roads require dust suppression and that dirt and gravel roads be maintained daily during construction, drilling, and completions with year-round periodic maintenance during operations. Dust suppression would be implemented by spraying water on unpaved roads on an as-needed basis with more consistent abatement during construction, drilling, and completions. Magnesium chloride and other surfactants, binding agents, or other dust-suppression chemicals may be used for dust control with County and/or land owner approval but not within 400 feet of any drainage.
- Weld County roads into the project area would be upgraded with hardened, dust-resistant surfacing to reduce dust emissions where practical.
- Noble proposes to use dual-fuel liquefied natural gas/natural gas drill rig engines (i.e., engines that can be fueled by liquefied natural gas [LNG] or diesel) that would be fueled by LNG and would meet 40 CFR Part 60 Subpart JJJJ.
- Noble would use supervisory control and data acquisition (SCADA) systems to monitor well operations, which would reduce emissions from vehicle traffic due to the reduced number of vehicle trips to the site.
- Noble would install vapor recovery towers and vapor recovery units to capture the majority of the flash gas between the separator and the tanks. The remainder of the flash gas off the tanks would be captured and sent to a burner or rerouted back to the production facility.
- Noble would use no bleed pneumatic control valves at both the well heads and the production facilities.
- Noble would use field gas to operate compressor engines instead of diesel.
- Noble would use solar and/or natural gas powered Gensets to operate equipment such as lights and SCADA on the EcoNodes.
- Noble would install equipment to control loadout emissions.
- Tanks would also be constructed in accordance with Air Quality Control Commission Regulation Number 7.
- Noble would implement a Leak Detection and Repair program (LDAR). The LDAR would involve monthly or quarterly site inspections using infrared (e.g., FLIR) cameras.

Cultural Resources

- All surface-disturbing activities would be conducted so as to avoid any impacts to eligible cultural resources.
- In the event of inadvertent discovery of cultural resources, construction activities would be halted and proper notifications would be made, as needed. Specifically, prior to surface disturbing activities, a third party would provide a Discovery Plan to Noble, which would be used to provide cultural resources training to all construction vendors and internal employees. The Plan would be immediately implemented if a resource is discovered during construction.

Construction activities would not resume until authorization is provided by Noble and appropriate agencies.

Interim Reclamation and Invasive Plant Control

- As technically and economically feasible, and as approved by the private surface landowner, reclamation and weed control would be conducted in accordance with the guidelines included in the CPW's Actions to Minimize Adverse Impacts to Wildlife Resources, dated October 27, 2008 and updated March 16, 2012 (CDOW 2008).
- Noble would implement an integrated weed management plan (Noble 2015a).

Migratory Birds

- Pursuant to BLM Instruction Memorandum 2008-050, to reduce impacts to Birds of Conservation Concern (BCC), construction, drilling, or completion activities that are initiated prior to March 1st may continue through the breeding season because it is assumed loss of suitable breeding habitat occurred in the project area prior to the start of the breeding season
- No habitat disturbance (removal of vegetation such as timber, brush, or grass) would occur between May 15 and July 15, during the breeding and brood rearing season for most Colorado migratory birds. An exception to this timing limitation could occur if nesting surveys conducted no more than one week prior to surface-disturbing activities indicate no nesting birds within 30 meters (100 feet) of the area to be disturbed. Surveys would be conducted by a qualified breeding bird surveyor between sunrise and 10:00 a.m. under favorable conditions. This provision does not apply to ongoing construction, drilling, or completion activities that are initiated prior to May 15 and continue into the 60-day period.
- Noble would construct, modify, equip, and maintain all open-vent exhaust stacks on production equipment to prevent birds from entering, and to discourage perching, roosting, and nesting. Production equipment includes, but may not be limited to, tanks, heater-treaters, separators, dehydrators, flare stacks, and in-line units. Any action that may result in a "take" of individual migratory birds or nests that are protected by the Migratory Bird Treaty Act (MBTA) would not be allowed.

Sensitive Species (BLM and/or USFS)

For prairie dogs Noble would:

- Survey for active and inactive prairie dog colonies within development areas prior to development.
- Avoid construction on or in prairie dog colonies wherever possible.
- Where oil and gas activities must occur on or in white-tailed prairie dog colonies, conduct these activities outside the period between March 1 and June 15.
- Manage oil and gas activities within prairie dog colonies to minimize impacts to attributes that maintain the functional integrity of the prairie dog colony (e.g., vegetation, soils, burrow systems, etc.).
- Minimize road development and close roads to recreational use.

- Promptly reclaim disturbed areas within prairie dog colonies with native grasses and forbs appropriate to the ecological site.
- Aggressively control non-native and invasive weeds, particularly cheatgrass, in reclamation areas within prairie dog habitat.
- Install raptor perch deterrents on equipment, fences, cross arms and pole tops in prairie dog habitat.

For ferruginous hawk Noble would:

- Commit to no surface occupancy (beyond that which historically occurred in the area) within 0.5 mile of active nest sites and associated alternate nests.
- No human encroachment or construction activity within 0.5 mile of any active ferruginous hawk nest or alternate nest site from February 1 to July 15.

For burrowing owls Noble would:

- Adhere to recommended survey protocol and actions to protect nesting burrowing owls (e.g. survey active and inactive prairie dog colonies for presence of burrowing owls when construction will occur between March 1 and October 31).
- Conduct surface disturbance within 300 feet of any active burrowing owl nest site outside the period between March 1 and August 15.

For mountain plover Noble would:

- Survey suitable nesting habitat within the known range of mountain plover that is proposed for development during the appropriate season. Flag active nests and apply the seasonal restriction described below.
- No surface occupancy within 300 feet of active mountain plover nest sites until young are hatched and independent of nest.

For swift fox Noble would:

- Utilize native vegetation for reclamation within swift fox overall range.
- Restrict use of pesticides for rodent control in swift fox overall range.

Soil Resources

- Noble would implement a Field Wide Stormwater Management Plan for Construction Activities (Noble 2015b). Key BMPs from that document are included here:
    - All available topsoil would be removed from the well pad areas and stockpiled/stored adjacent to the well pad in order to retain indigenous seed bank and soil microbes that are fundamental to site restoration. Topsoil salvage depths would be determined prior to construction activities and topsoil would be stored in a manner to maintain viability. Salvaged topsoil would be stabilized using methods including permeable covers or seeding.
    - Energy dissipaters such as straw bales or silt fences would be used to prevent excess erosion of soils from disturbed areas. These structures would be installed during construction and left in place and maintained for the life of the project or until the disturbed slopes have been revegetated and stabilized.

- Noble would limit construction activities during wet periods to avoid excess disturbance of areas surrounding operations.
- Unless specifically requested by the landowner, all roads and pads would be contoured and revegetated to a stable condition.

Terrestrial Wildlife

For general terrestrial wildlife species Noble would:

- As technically and economically feasible, and provided the private surface landowner agrees, Noble would implement the CPW's Actions to Minimize Adverse Impacts to Wildlife Resources, dated October 27, 2008 and updated March 16, 2012 (CDOW 2008). This document includes a suite of salient measures and project design features intended to reduce, avoid, or offset potential impacts to wildlife habitats and populations for oil and natural gas development.
- Noble would provide education for employees and contractors on wildlife-friendly practices.
- Noble would work with landowners to identify and protect wildlife populations and habitats.
- Noble would not utilize reserve pits or other open pits for wastewater, which would reduce the potential impacts to bird species.
- Unless specifically requested by landowner, all roads and pads will be contoured and re-vegetated to a stable condition to restore natural habitats for wildlife species.

For general raptor species Noble would:

- Prior to ground disturbing activities, determine either through consultation with CPW or surveys the locations of raptor nesting and roosting sites.
- Provide raptor survey data for incorporation into the CPW raptor database.
- Consult with and implement CPW recommendations regarding raptor protection measures including seasonal timing restrictions and recommended buffer zones.
- Avoid disturbance of raptor nesting habitat during the breeding season (variable by species--January 1 to July 15).
- Avoid impacts to raptor roost sites during the wintering period (variable by species--November 15 to April 1).
- Survey any suitable habitat (cliffs, large trees, snags) within 1 mile of a proposed project site for raptor nests. Where raptor nests are found, site the project to provide a suitable buffer zone, and/or place sufficient seasonal limitations on construction activity to protect the nest site.
- While not included in the CPW recommendations, Noble would also ensure all disturbances are brush hogged prior to April 1st or ground nesting surveys will be required 72 hours prior to surface disturbances.

Threatened and Endangered Species

Noble has committed to maintaining membership in good standing in the South Platte Water Related Activities Program, Inc. (SPWRAP) organization.

Transportation and Access

- Noble would use existing oil and gas infrastructure, to the greatest extent possible. Noble's design for the Proposed Action includes a combination of multi-well pads and EcoNodes. Consolidating well pad and production facilities into three main areas of development allows for a reduction in the number of new roads that would be constructed and limits the number of existing roads that require improvement.
- Noble would utilize existing and newly constructed pipelines to reduce traffic required for the production phase of this project.
- Noble would utilize existing and new water wells and an existing water pipeline in the Project Area for water necessary for development which would reduce long-distance water truck traffic.
- Noble would use SCADA to reduce the frequency of vehicle trips to the Project Area to monitor well operations.
- Noble would implement a Transportation Plan to guide the management of transportation throughout the implementation of the proposed project (Noble 2015c).

Visual Resources

- All above ground structures remaining on site longer than six months would be painted a flat, non-reflective, earth tone color to blend with the surrounding landscape, as agreed to by the landowner.

Wastes, Hazardous or Solid

- Noble will implement a Spill Prevention, Control, and Countermeasure plan (Noble 2012).

Water Resources (Surface and Groundwater)

- Noble would design water recycling capabilities at mobile treatment units to recycle and re-use of up to 50 percent of the water by-products.
- Energy dissipaters such as straw bales or silt fences would be installed during construction and can be left in place and maintained for the life of the project or until the disturbed slopes have been revegetated and stabilized.
- Noble would use SCADA to allow for rapid well shutdown in the event of a potential release.
- Unless specifically requested by landowner, all roads and pads would be contoured and revegetated to a stable condition to minimize erosion.

2.2.2 No Action Alternative

The Proposed Action involves drilling on private surface estate over private and federal mineral estate in order to produce federal and private minerals associated with existing federal leases, which grant the lessee a right to explore and develop the leases. Although the BLM cannot deny the right to drill and develop the leasehold, individual APDs can be denied. The No Action alternative constitutes denial of the APDs associated with the Proposed Action. However, because BLM has limited authority over the private surface estate under the No Action alternative, the applicant could explore and develop the private land and private minerals while avoiding well completion in the federal mineral estate within the project area, which may result in environmental impacts similar to the impacts of the proposed action. Previous development of existing well pads, roads, and pipelines in the Project Area has resulted in approximately 300 acres of surface disturbance.

2.3 Alternatives Considered but not Analyzed in Detail

No other alternatives were considered due to the proposed project being a non-discretionary action taking place on privately owned surface.

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CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

3.1 Introduction

This section provides a description of the human and natural environmental resources that could be affected by the Proposed Action and No Action alternatives. This section also presents comparative analyses of the direct, indirect, and cumulative effects on the affected environment stemming from the implementation of the actions under the Proposed Action and No Action alternatives. The analysis area for all resources is the Project Area. The Project Area boundary includes existing project features (i.e., water supply wells) and lands that would be disturbed for the proposed project. Additionally, the Project Area includes Noble's leased federal minerals, which are surrounded by at least a 1.25 mile radius of either unleased federal minerals or private minerals. The majority of this land would have no surface activity related to the project; surface disturbance would occur on less than 4 percent of the Project Area and would be reclaimed in the interim to approximately 141 acres, which is less than 2 percent of the Project Area. Figures 2-2 and 2-3 show the Project Area. Oil and gas extraction activities, livestock grazing, dryland farming, and associated surface disturbance have historically affected the Project Area.

3.1.1 Interdisciplinary Team Review

The Bureau of Land Management (BLM) Royal Gorge Field Office (RGFO) interdisciplinary team (ID team) conducted internal scoping by reviewing the proposal, its location, and a resources/issues list, to identify potentially affected resources, land uses, resource issues, regulations, and site-specific circumstances (Appendix A). This Environmental Assessment (EA) does not discuss resources and land uses that are not present; it briefly addresses those resources that are present but not managed by the BLM due to the private surface estate ownership for the Proposed Action.

This EA analyzes the following issues in detail:

- Air quality and climate
- Geologic and mineral resources
- Prime and unique farmlands
- Soil resources
- Water resources
- Invasive plants
- Terrestrial wildlife
- Threatened, endangered, and proposed species
- Migratory birds
- Cultural resources
- Native American religious concerns
- Paleontological resources
- Socioeconomics

The following resources are present but not managed by the BLM due to the private surface estate ownership; therefore, these resources are addressed briefly in this EA:

- Sensitive species (BLM and USFS Region 2)
- Visual resources
- Noise
- Wastes, hazardous or solid
- Transportation and access

The following resources and resource uses are not present in the Project Area, or are program areas that are not managed by the BLM on privately owned surface lands; therefore, they are not included in this EA:

- Wetlands and riparian areas
- Aquatic wildlife
- Environmental justice
- Recreation
- Lands and realty
- Lands with wilderness characteristics, Wilderness Study Areas, and Areas of Critical Environmental Concern
- Wild and Scenic Rivers
- Range management
- Forest management
- Cadastral survey
- Fire
- Law enforcement

3.2 Physical Resources

3.2.1 Air Quality and Climate

Affected Environment

Air quality in an area is generally influenced by the quantities of pollutants that are released within and upwind of the area, and can be highly dependent upon the pollutants' chemical and physical properties. Air quality standards and regulations limit the allowable quantities that may be emitted. The topography, weather, and land use in an area also will affect how pollutants are transported and dispersed and the resulting ambient concentrations. Air quality conditions and compliance with standards are determined by measuring ground-level pollutant concentrations.

Applicable Standards and Regulations

The Clean Air Act (CAA), which was last amended in 1990, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS), codified by 40 Code of Federal Regulations (CFR) Part 50, for "criteria" pollutants. Criteria pollutants are air contaminants that are commonly emitted from a variety of sources and include carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2), particulate matter smaller than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively), ozone (O_3), and nitrogen dioxide (NO_2). Ambient air quality standards must not be exceeded in areas where the general public has access.

The CAA established two types of NAAQS:

Primary standards: Primary standards set limits to protect public health, including the health of "sensitive" populations (such as asthmatics, children, and the elderly).

Secondary standards: Secondary standards set limits to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings.

The EPA regularly reviews the NAAQS (every five years) to ensure that the latest science on health effects, risk assessment, and observable data such as hospital admissions are evaluated, and can revise NAAQS if the data supports a revision. The Colorado Air Pollution Control Commission can establish state ambient air quality standards for any criteria pollutant, and those standards must be at least as stringent as the federal standards. Table 3-1 lists the federal and Colorado ambient air quality standards.

Table 3-1. National and Colorado Ambient Air Quality Standards

Pollutant [final rule citation]		Standard Type	Averaging Period	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		Primary	8-hour	9 ppm[a]	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		Primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		Primary and secondary	Annual	53 ppb	Annual mean
Ozone [73 FR 16436, Mar 27, 2008][b]		Primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter [73 FR 3086, Jan 15, 2013]	$PM_{2.5}$	Primary	Annual	12 μg/m^3	Annual mean, averaged over 3 years
		Secondary	Annual	15 μg/m^3	Annual mean, averaged over 3 years
		Primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm[c]	Not to be exceeded more than once per year

Source: National – 40 CFR 50, Colorado – 5 CCR 1001-14.

[a] mg/m3 = milligrams per cubic meter, μg/m3 = micrograms per cubic meter, ppb = parts per billion, ppm = parts per million.
[b] On November 25, 2014, the EPA proposed to strengthen the NAAQS for ground-level ozone (79 FR 75234). EPA is proposing to revise the primary standard to a level within the range of 0.065 to 0.070 ppm, and to revise the secondary standard to within the range of 0.065 to 0.070 ppm. As of June 2015 EPA has not issued a final rule, and the 2008 standard remains in force.
[c] Colorado Ambient Air Quality Standard for 3-hour SO2 is 0.267 ppm.

For areas that do not meet the NAAQS (these are designated by EPA as nonattainment areas), the CAA establishes timetables for each region to achieve attainment of the NAAQS. The State (Colorado Department of Public Health and Environment [CDPHE]) must prepare a State Implementation Plan (SIP), which documents how the region would reach attainment by the required date. A SIP includes inventories of emissions within the area and establishes emission budgets (targets) and emission control programs that are designed to bring the area into compliance with the NAAQS. In maintenance areas (former nonattainment areas that have achieved attainment), SIPs document how the State intends to maintain compliance with NAAQS.

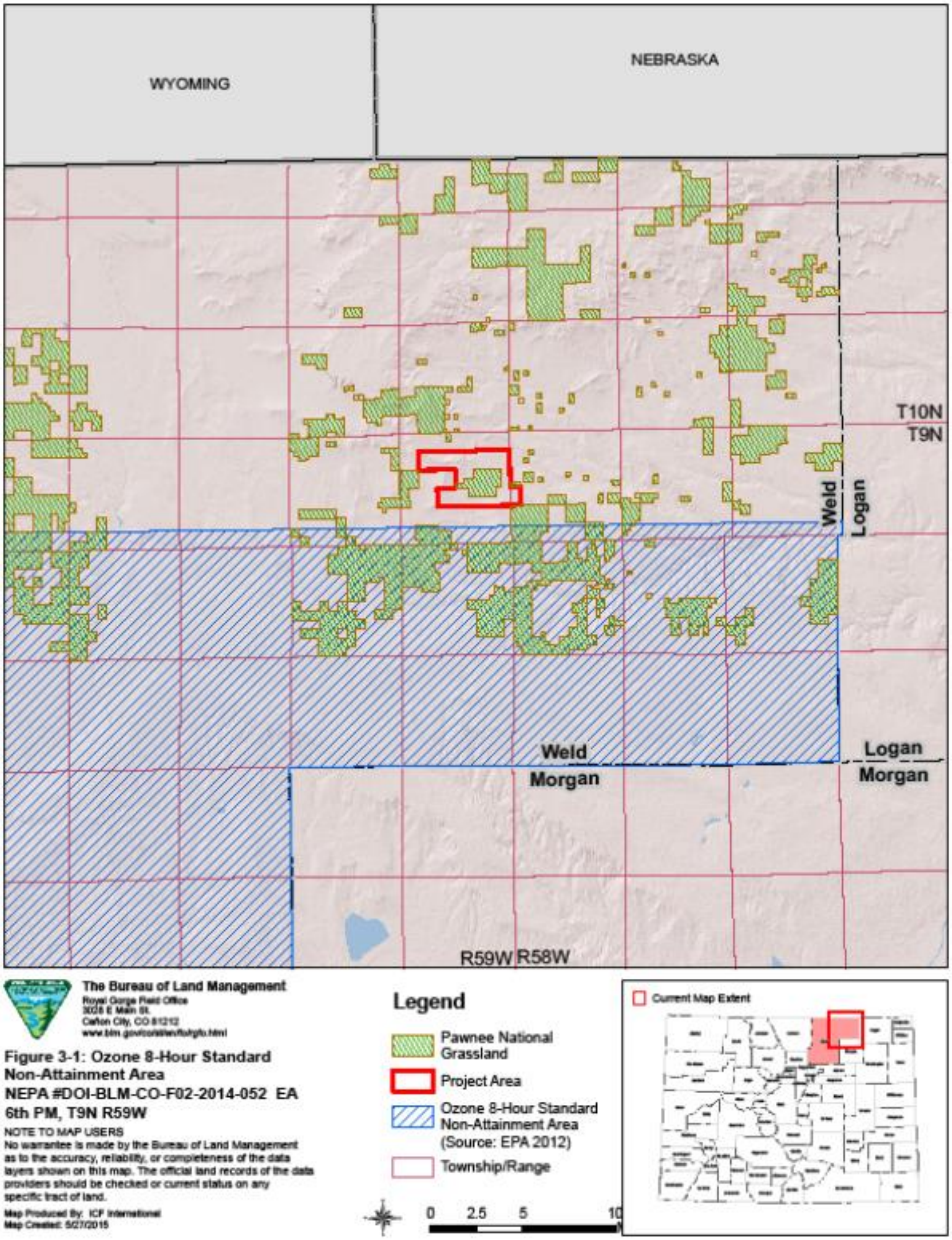
In addition to the criteria pollutants, EPA regulates emissions of hazardous air pollutants (HAPs). HAPs are chemicals that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. EPA currently lists 188 identified compounds as HAPs, some of which can be emitted from oil and gas development operations, such as benzene, toluene, and formaldehyde. EPA has not established ambient air quality standards for HAPs; rather EPA regulates HAPs through emissions standards that are specific to each source type or industrial sector responsible for the emissions.

The CAA and the Federal Land Policy and Management Act of 1976 (FLPMA) require the BLM and other federal agencies to ensure actions taken by the agency comply with federal, state, tribal, and local air quality standards and regulations. FLPMA further directs the Secretary of the Interior to take any action necessary to prevent unnecessary or undue degradation of the lands [Section 302 (b)], and to manage the public lands "in a manner that would protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" [Section 102 (a)(8)].

Section 176(c) of the CAA prohibits Federal entities from taking actions in nonattainment or maintenance areas that do not "conform" to the SIP. The purpose of this conformity requirement is to ensure that Federal activities: (1) do not interfere with the budgets in the SIPs; (2) do not cause or contribute to new violations of the NAAQS; and (3) do not impede the ability to attain or maintain the NAAQS. To implement CAA Section 176(c), EPA issued the General Conformity Rule (40 CFR Part 93, Subpart B), which applies to all Federal actions not funded under U.S.C. Title 23 or the Federal Transit Act. (BLM actions are not funded by U.S.C. Title 23 or the Federal Transit Act.) The General Conformity Rule established emissions thresholds (40 CFR 93.153), known as *de minimis* levels, for use in evaluating the conformity of a project. If the net emissions increases due to the project are less than these thresholds, the project is presumed to conform and no further conformity evaluation is required. If the emissions increases exceed any of these thresholds, a conformity determination is required. The conformity determination can entail air quality modeling studies, consultation with the EPA and state air quality agencies, and commitments to revise the SIP or to implement measures to mitigate air quality impacts. The BLM, as the federal entity with jurisdiction for the Proposed Action, must demonstrate that the Proposed Action meets the requirements of the General Conformity Rule.

The Project Area is located in an area designated attainment for all pollutants (EPA, 2012). Accordingly, the proposed wells are not subject to the conformity requirements. The project area extends to about 1.5 Km (0.94 mile) from the northern boundary of EPA-designated Denver-Boulder-Greeley-Fort Collins ozone nonattainment area, which is managed under the Denver region ozone SIP. Figure 3-1 depicts the project location with respect to the nonattainment area.

Figure 3-1. Project Location and Ozone Nonattainment Area



The Prevention of Significant Deterioration (PSD) provision of the CAA established Class I areas in which very little degradation of air quality is allowed (e.g., national parks and large wilderness areas) and Class II areas which encompass all non-Class I areas. The PSD Class II designation allows for moderate degradation of air quality within certain limits above baseline air quality. The Project Area is designated as a Class II area. The closest Class I area to the proposed well site locations is Rocky Mountain National Park, which lies approximately 90 miles to the west. Class I and sensitive Class II areas are included in the analysis because potential impacts on air quality related values (AQRVs) (resources that are affected by air pollution, including scenic, cultural, biological, physical, ecological, or recreational resources) are assessed in these areas.

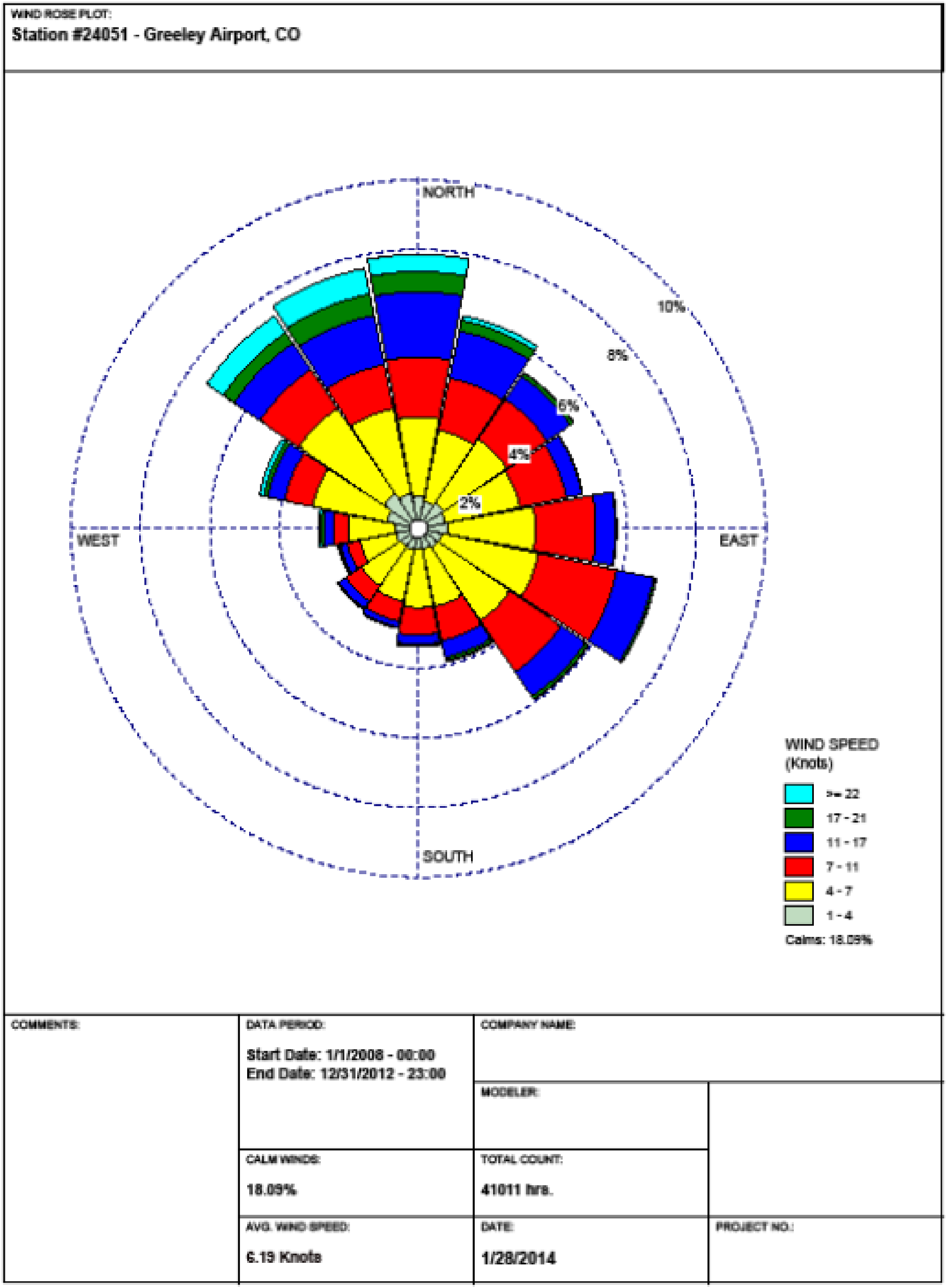
Land Use in the Project Region

The vicinity of the Project Area (northeastern Weld County) is predominantly used for agriculture (Weld County 2015a). Portions of the Project Area are designated is part of the Pawnee National Grasslands. The small town of Raymer Town (also known as New Ramer), population 96 in 2010 (USCB 2014a), lies to the southwest of the Project Area. The population density of Weld County is generally low and dispersed, with 63 people per square mile (USCB 2013). Approximately 75% of the available land area of Weld County is linked to the agricultural sector of the economy. Oil and gas development is another major economic driver for the area, and Weld County has some 17,000 active wells within its boundaries (BLM, 2012). Activities occurring within the area that affect air quality include exhaust emissions from motor vehicles, agricultural equipment, drilling rigs and other oil and gas development activities, as well as fugitive dust from roads, agriculture, and energy development (BLM 2012b).

Meteorology in the Project Region

Mean temperatures in the area range from 27.8 degrees Fahrenheit (°F) in January to 74.0° F in July. The area receives average annual precipitation of approximately 14.22 inches (NOAA 2013). Over the course of the year, typical wind speeds vary from 0 mph to 20 mph. The highest daily average wind speed of 10 mph occurs in April, and the lowest daily average wind speed of 5 mph occurs in August (Weatherspark 2013). Figure 3-2 presents a wind rose for observations made at Greeley Airport during 2008-2012. Figure 3-2 shows that the predominant wind directions are from the north through northwest and the east through southeast.

Figure 3-2. Wind Rose for Greeley, CO Airport



Existing Air Quality Measured in the Region

The CDPHE Air Pollution Control Division (APCD) measures ambient air quality at a number of locations throughout Colorado. The Wyoming Department of Environmental Quality does the same throughout Wyoming. The nearest state-operated air monitors to the Project Area are the Weld County West Annex (measuring CO), County Tower (measuring O_3), and Hospital (measuring PM_{10} and $PM_{2.5}$) stations located in Greeley, Colorado, and the North Cheyenne Soccer Complex station located in Cheyenne, Wyoming (measuring NO_2 and SO_2). Table 3-2 provides the measured concentrations of criteria pollutants at these monitoring stations for the most recent three years. There are no lead monitors near the Project Area. Table 3-2 indicates that no violations of the NAAQS have occurred in the project region in the last three years.

Table 3-2. Measured Ambient Concentrations in the Region

Monitor Location (EPA Site Identifier)	Pollutant (Averaging Period – Unit, Form)	Measured Concentration		
		2012	2013	2014
Weld County West Annex, Greeley, CO (08-123-0010)	CO (1 Hour - ppm, maximum)	3.2	3.3	2.7
	CO (8 Hour - ppm, maximum)	2.3	1.7	1.7
Weld County Tower, Greeley, CO (08-123-0009)	O_3 (8 Hour - ppm, 4th maximum)	0.080	0.073	0.070
North Cheyenne Soccer Complex, Cheyenne, WY (56-021-0100)	NO_2 (1 Hour - ppb, 98th percentile)	35.8	19.7	17.5
	NO_2 (Annual - ppb, annual mean)	3.8	4.1	3.5
Weld County Health Dept. (Hospital), Greeley, CO (08-123-0006)	PM_{10} (24 Hour - µg/m^3, maximum)	102	50	60
	$PM_{2.5}$ (24 Hour - µg/m^3, 98th percentile)	32	20.5	35.2
	$PM_{2.5}$ (Annual - µg/m^3, annual mean)	8.1	7.2	7.3
North Cheyenne Soccer Complex, Cheyenne, WY (56-021-0100)	SO_2 (1 Hour - ppb, 99th percentile)	7.3	5.8	3.5
	SO_2 (3 Hour - ppb, maximum)	4.9	12.0	6.3

Source: EPA 2015a

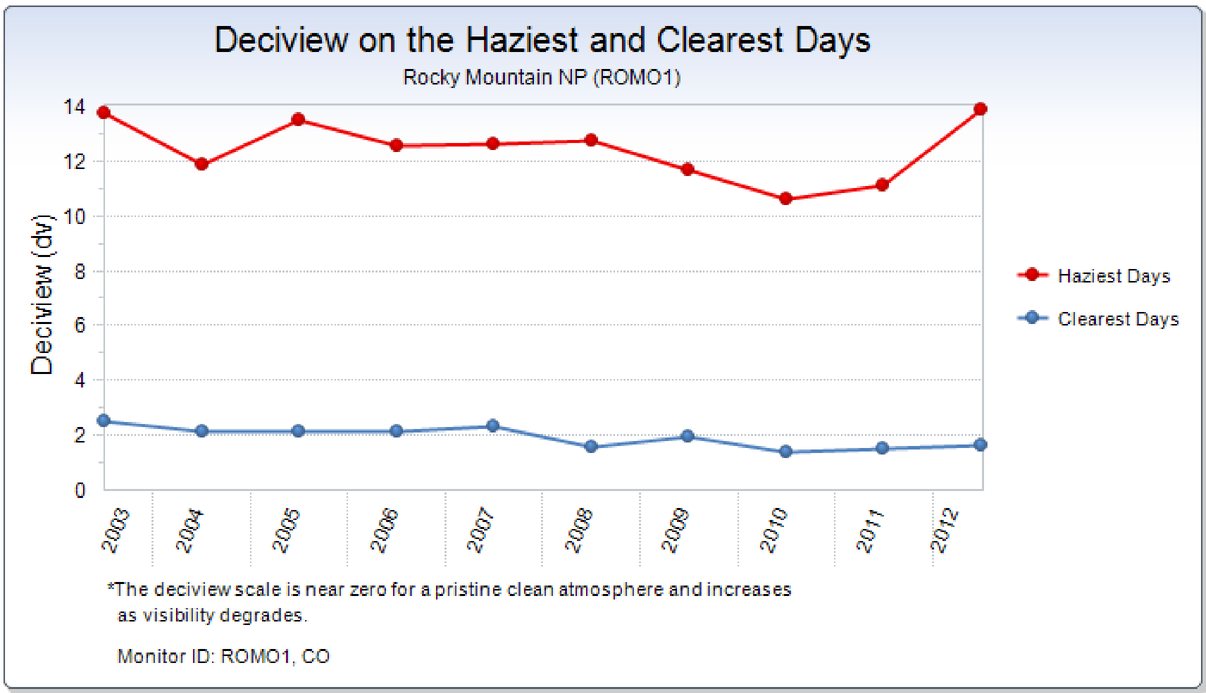
Air Quality Related Values

AQRVs are important to Federal land managers (FLMs) because they have a mandate to ensure their Class I and sensitive Class II areas meet scientific (e.g., landscape nutrient loading) and congressionally mandated goals (e.g., regional haze). The most common metrics for assessing impacts on AQRVs are visibility and deposition.

Visibility impacts occur when emissions absorb and scatter light in the atmosphere, causing haze and reducing the clarity of views. Regional haze impairs visibility and is produced by emissions from numerous sources located across broad geographic areas. Regional haze is made up of directly- emitted $PM_{2.5}$ and secondary $PM_{2.5}$, which is formed from chemical reactions of fine particle precursors in the atmosphere. $PM_{2.5}$ precursors include emissions of SO_2 and other sulfur oxides (SO_x), nitrogen oxides (NO_x), ammonia, and VOCs. The most important secondary $PM_{2.5}$ particles for visibility impairment are nitrates and sulfates, which are formed from emissions of NO_x and SO_x, respectively.

Visibility is measured over 24-hour periods and calculated as a percent increase in light extinction (reduced visibility) compared to a presumed pristine background. Impacts are expressed in deciviews, a measure of visibility impairment. A visibility reduction of 10 percent corresponds to 1.0 deciview, which represents human perception of a just noticeable change. Monitors in the nationwide federal Interagency Monitoring of Protected Visual Environments (IMPROVE) network provide information on current visibility levels and trends in visibility. The nearest IMPROVE monitor to the study area is located in Rocky Mountain National Park. Figure 3-3 shows visibility levels as measured at this monitor. In general, trends with a negative slope (downward left-to-right) indicate declining impacts (improving atmospheric conditions).

Figure 3-3. Visibility Data for Rocky Mountain National Park

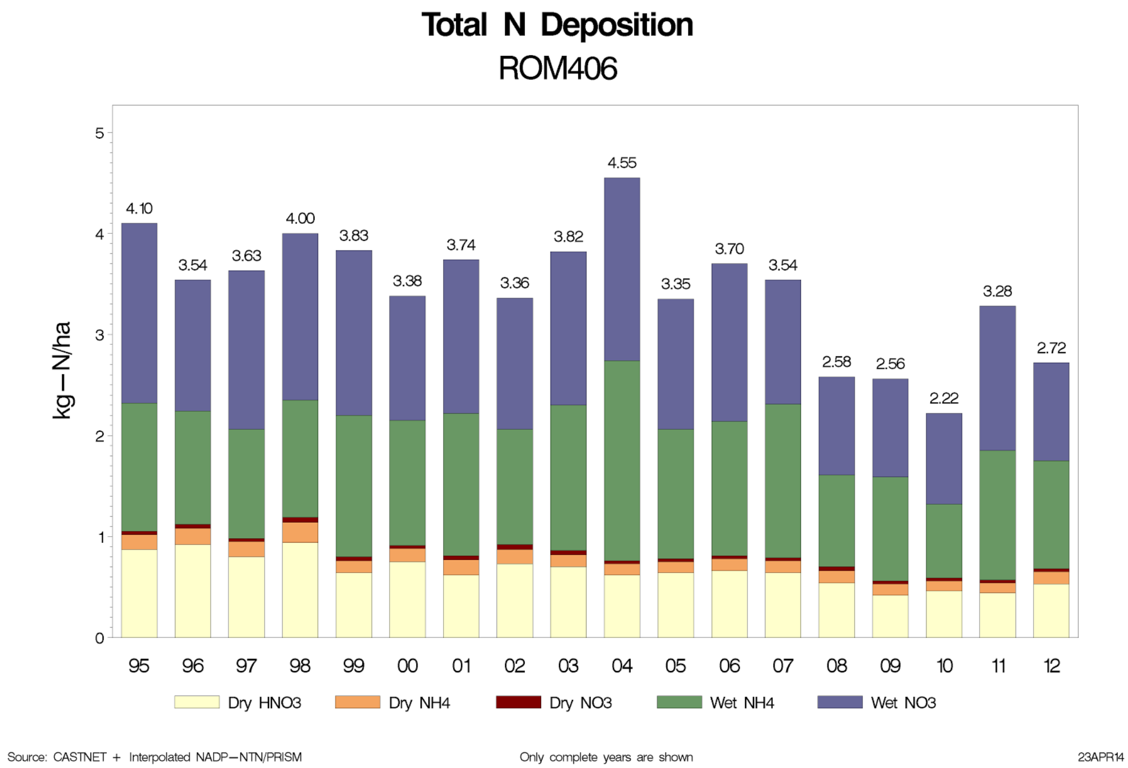


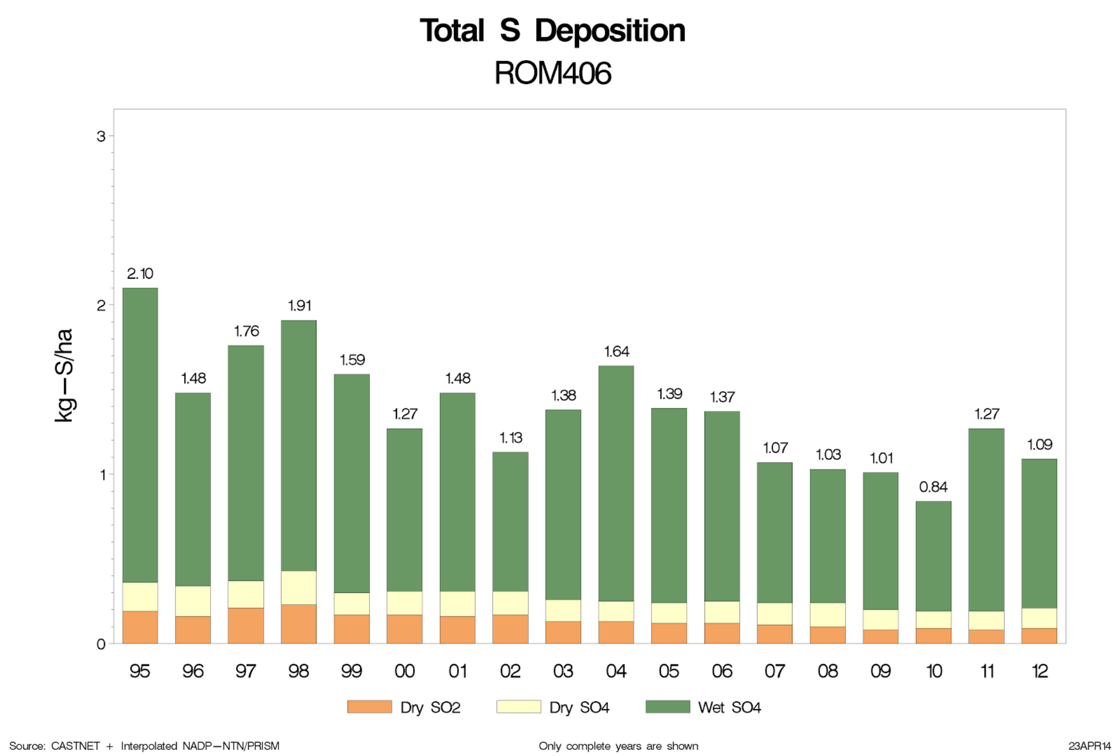
Source: Colorado State University 2015.

Acidic deposition occurs when nitrates, sulfates, ammonium, and nitric acid, among other compounds, are formed in the atmosphere as a result of emissions of SO_x and NO_x, and are deposited to soil, vegetation, and surface water. Acid deposition to lakes can impair water quality by reducing their acid-neutralizing capacity. Pollutant deposition also can cause excess nutrient loading in soils and water.

A recent study suggests that the critical nitrogen load value for high elevation surface water in all natural areas of Colorado is 2.3 kg/ha-yr (Rodriguez *et al.*, 2014). The NPS *Technical Guidance on Assessing Impacts on Air Quality in NEPA and Planning Documents* (NPS, 2011) suggests that critical sulfur load values above 3 kg/ha-yr may result in moderate impacts. Monitors in the interagency Clean Air Status and Trends Network (CASTNET) provide information on current acid deposition levels and trends in deposition. The CASTNET deposition monitor with available air quality trend data nearest to the study area is located in Rocky Mountain National Park. Figure 3-4 shows acid deposition levels and trends as measured at this monitor. In general, trends with a negative slope indicate declining impacts (improving atmospheric conditions).

Figure 3-4. Nitrogen (N) and Sulfur (S) Deposition Data for Rocky Mountain National Park





Source: EPA 2015b

Greenhouse Gases and Climate Change

There is broad scientific consensus that humans are changing the chemical composition of Earth's atmosphere. Activities such as fossil fuel combustion, deforestation, and other changes in land use are resulting in the accumulation of trace greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several industrial gases in the Earth's atmosphere. An increase in GHG emissions is said to result in an increase in the earth's average surface temperature, primarily by trapping and thus decreasing the amount of heat energy radiated by the Earth back into space. The phenomenon is commonly referred to as global warming. Global warming is expected in turn, to affect weather patterns, average sea level, ocean acidification, chemical reaction rates, and precipitation rates, which is collectively referred to as climate change. The Intergovernmental Panel on Climate Change (IPCC, 2007) has predicted that the average global temperature rise between 1990 and 2100 could be as great as 5.8°C (10.4°F), which could have massive deleterious impacts on the natural and human environments. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and the burning of fossil carbon fuel sources have caused GHG concentrations to increase measurably, from approximately 280 ppm in 1750 to over 400 ppm as of April 2015 (NOAA, 2015). The rate of change has also been increasing as more industrialization and population growth is occurring around the globe. This fact is demonstrated by data from the Mauna Loa CO_2 monitor (NOAA, 2015) in Hawaii that documents atmospheric concentrations of CO_2 going back to 1960, at which time the average annual CO_2 concentration was recorded at approximately 317 ppm. The record shows that approximately 70% of the increases in atmospheric CO_2 concentration since pre-industrial times occurred within the last 54 years.

Existing Oil and Gas Production in the Region

Current oil and gas production rates convey the level of activity of oil and gas development in the region around the proposed action. Table 3-3 shows the current oil and gas production levels by county (well counts and production numbers are for both federal and fee minerals) for Weld County, which contains the proposed action, and nearby counties: Adams, Arapahoe, Logan, and Morgan in Colorado, Laramie County in Wyoming, and Cheyenne and Kimball Counties in Nebraska. Table 3-3 indicates that most of the oil and gas production in the region occurs in Weld and Laramie Counties.

Table 3-3. Annual Production Data for the Region

County, State	Max. No. of Producing Wells (2014)	Annual Production (2014)		
		Oil (bbl)	*Natural Gas (Mcf)*	*Produced Water (bbl)*
Adams, CO	1,170	25,539	325,539	97,403
Arapahoe, CO	179	903,562	1,566,011	489,898
Logan, CO	191	195,144	350,399	6,102,322
Morgan, CO	220	115,092	428,428	3,840,768
Weld, CO	25,997	73,828,612	366,714,112	25,018,001
Laramie, WY	218	3,587,111	3,459,376	NR[a]
Cheyenne, NE	163[b]	194,655[c]	421,124[c]	NR
Kimball, NE	111[b]	467,503[c]	57,924[c]	NR

Sources: Colorado – COGCC 2015b. Wyoming and Nebraska – Drilling Edge 2015a.

[a] NR = Not Reported.
[b] Number of leases.
[c] Data for 2013.

Existing Emissions in the Region

The existing levels of total emissions from all sources in a region provide an indicator of regional air quality as well as context for the emissions from the proposed action. Table 3-4 provides emissions inventory information for all sources in Weld County, which contains the proposed action, and nearby counties. Table 3-4 provides emissions data for 2011 which is the most recent year for which data are available.

Table 3-4. Regional Emissions from All Sources by County

County, State	2011 Emissions (tons per year)										
	PM_{10}	*$PM_{2.5}$*	*VOC*	*CO*	*NO_X*	*SO_2*	*CO_2*	*CH_4*	*N_2O*	*NH_3*	*HAPs*
Adams, CO	14,174	4,298	22,243	75,017	25,245	8,032	2,720,429	191	110	1,361	4,290
Arapahoe, CO	13,423	3,287	19,381	93,672	13,022	208	2,778,947	175	142	646	4,399
Logan, CO	7,666	1,719	11,066	9,746	4,374	101	220,853	22	7	4,520	2,839
Morgan, CO	6,572	1,621	9,786	12,750	7,997	13,082	283,035	56	10	5,412	2,600
Weld, CO	27,904	6,184	150,982	78,597	32,696	502	1,842,356	241	75	16,091	8,990
Laramie, WY	35,765	4,924	15,305	24,366	11,922	348	962,362	69	33	3,972	3,786
Kimball, NE	4,102	734	15	3,495	3,277	4,810	196,653	17	2	186	1,264
Cheyenne, NE	7,923	1,560	6,722	5,776	5,002	26	257,750	7	4	1,430	1,789

Source: EPA 2015c

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Direct and Indirect Impacts of Criteria Pollutants and HAPs: The Proposed Action would have a temporary, localized negative impact to air quality during the development (construction) phase. Surface disturbance, construction and utilization of access roads, and development activities such as drilling, hydraulic fracturing, well completion, and equipment installation would impact air quality through the generation of dust related to earthmoving, travel, transport, and general construction. This phase would also produce short-term emissions of criteria pollutants, HAPs, and GHGs from vehicle and construction equipment exhaust. Once construction is complete, the daily activities at the well pads and EcoNodes would be reduced to operational and maintenance checks which may be as frequent as daily visits. Emissions would result from vehicle exhaust from the maintenance and process technician visits, as well as oil and produced water collection or load out trips. The EcoNodes can be expected to produce fugitive emissions of well gas and liquid flashing gases, which contain a mixture of methane, VOCs, HAPs, and inert or non-regulated gases. Fugitive emissions are emissions that are not associated with a stack, exhaust vent, or other defined point. Fugitive emissions may result from pressure relief valves and working and breathing losses from any tanks located at the sites, as well as any flanges, seals, valves, or other infrastructure connections used at the sites. Liquid product load-out operations would also generate fugitive emissions of VOCs.

Ozone is not directly emitted as are other criteria pollutants. Ozone is chemically formed in the atmosphere via reactions of ozone precursors, primarily NO_x and VOCs, in the presence of the ultraviolet component of sunlight. Ozone concentrations are the result of these complex reactions involving VOC and NO_x emissions from all sources within a region. Ozone concentrations change over time as these reactions continue while sunlight is present, and additional sources contribute emissions as air is transported across long ranges (as much as hundreds of miles). Therefore, prediction of potential impacts on ozone levels from individual projects like the Proposed Action is impractical, and potential ozone impacts are evaluated based on the project's emissions of VOCs and NO_x.

Emissions from construction and operation (production) of the proposed wells were estimated by the applicant and are provided in Table 3-5 below. The following pollutants were inventoried where an appropriate basis, methodology, and sufficient data exist: CO, NO_x (includes NO_2), $PM_{2.5}$, PM_{10}, SO_2, VOCs, HAPs, CO_2, CH_4, and N_2O. The emissions estimates were developed using reasonable scenarios for each activity. Annual production emissions were calculated based on full production activity for the entire year. Potential emissions were calculated for each well assuming the legally required control measures, operational parameters, and equipment configurations data that were provided by the applicant, as well as additional measures committed to by the applicant.

For details of the assumptions and calculations used in estimating project emissions see Appendix C-1.

Table 3-5. Estimated Emissions from the Proposed Action (U.S tons per year)

Source Description	Criteria Pollutants						HAPs (total)	Greenhouse Gases			
	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$		CO_2	CH_4	N_2O	CO_2e[d]
Construction/Development											
Construction	3.9	1.8	0.2	0.002	4.3	1.0	NR[a]	319.0	0.005	NR	692
Drilling	53.5	80.8	21.7	0.1	51.5	9.5	3.5	15,650.7	0.317	0.05	20,242
Completion	40.2	41.0	9.0	0.05	50.0	8.8	1.3	8,150.6	0.160	0.03	8,164
Interim Reclamation	0.1	0.1	0.01	0.0001	0.4	0.1	NR	13.6	0.0003	0.0001	NR
Wind Erosion	NA[b]	NA	NA	NA	13.9	2.1	NA	NA	NA	NA	NA
Total Construction/ Development[c]	**97.7**	**123.6**	**31.0**	**0.1**	**120.0**	**21.4**	**4.7**	**24,133.9**	**0.5**	**0.1**	**29,098**
Production											
Production Heaters	28.7	24.1	1.6	0.2	2.2	2.2	0.5	34,199.7	0.6	0.1	34,235
Storage Tanks	NA	NA	191.6	NA	NA	NA	11.2	NA	NA	NA	NA
Fugitives	NA	NA	6.0	NA	NA	NA	0.1	38.2	391.1	0.0	9,815
Pneumatics	NA	NA	0.00	NA	NA	NA	0.0	0.3	0.0	0.0	0.3
Generators	10.5	21.0	7.4	0.02	0.8	0.8	0.6	4,582.2	0.1	0.01	4,587
Truck Loading	NA	NA	0.7	NA	NA	NA	NR	NA	NA	NA	NA
Engines	514.5	1,029.0	360.1	1.1	20.3	20.3	66.5	223,853.8	4.2	0.4	224,085
Wellsite Flares	7.1	38.4	1.1	0.1	1.5	1.5	0.4	12,178.0	0.2	0.02	12,191
Wind Erosion	NA	NA	NA	NA	4.0	0.6	NA	NA	NA	NA	NA
Operations Vehicle	68.4	16.3	2.1	0.051	133.8	21.8	NR	7,400.3	0.1	0.0	7,405
Total Production[c]	**629.1**	**1,128.7**	**570.5**	**1.5**	**162.5**	**47.1**	**79.3**	**282,252**	**396.3**	**0.5**	**292,318**

Table 3-5. Estimated Emissions from the Proposed Action (U.S tons per year)

Source Description	Criteria Pollutants						HAPs (total)	Greenhouse Gases			
	NO_X	*CO*	*VOC*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*		*CO_2*	*CH_4*	*N_2O*	*CO_2e*[d]
Total Construction/ Development Plus First Year Operation[c]	**726.8**	**1,252.4**	**601.5**	**1.6**	**282.5**	**68.5**	**84.1**	**306,386**	**396.8**	**0.6**	**321,416**

Source: Noble Energy 2015d

[a] NR = Not Reported
[b] NA = Not Applicable
[c] Sum of individual values may not equal summary value due to rounding.
[d] CO_2e = CO_2 equivalent, based on 100-year Global Warming Potentials of CO_2 = 1, CH_4 = 25, and N_2O = 298 (40 CFR Part 98, Subpart A, Table A-1).

Table 3-6 compares the project production phase emissions to total Weld County emissions as inventoried by the CDPHE for 2011 (the most recent year available). It also shows Weld County's oil and gas area and point source emissions for the same period. (Point sources are larger individual sources that have a definable stack or other emission point. Area sources are smaller sources that are inventoried in aggregate by CDPHE.)

Table 3-6. Comparison of Proposed Action and Weld County Emissions

Pollutant	Emissions (tons per year)				
	Proposed Action (Production)	*Proposed Action (Production), as Percent of Total Weld County Emissions*	*Weld County Total (2011)*	*Weld County (2011) Oil & Gas Area Sources (included in county total)*	*Weld County (2011) Oil & Gas Point Sources (included in county total)*
NOx	629.1	1.9%	32,696	5,610	5,826
CO	1,128.7	1.4%	78,597	2,791	6,719
VOC	570.5	0.4%	150,982	15,120	6,181
PM_{10}	162.5	0.6%	27,904	387	117
$PM_{2.5}$	47.1	0.8%	6,184	NR[a]	NR
SOx	1.5	0.3%	502	60	53
HAPs	79.3	0.9%	8,990	NR	62[b]

Source: Weld County totals – EPA 2015c. Weld County oil and gas sources – CDPHE 2015

[a] NR = Not Reported
[b] CDPHE oil and gas HAP inventories are for benzene only.

Table 3-6 shows that the project production emissions are relatively small compared to the Weld County emissions: 1.9 percent or less for each pollutant.

Air quality impacts were assessed in terms of potential pollutant concentrations that could result from the Proposed Action emissions. An air quality dispersion modeling assessment was performed to evaluate maximum air pollutant impacts at nearby residences and Pawnee National Grasslands receptors[2] in the near field (local area) due to the Proposed Action. For this assessment the near field is considered to be the area within a radius of approximately 12 kilometers (7.5 miles) from the center of the project area (see Appendix C-2). Although the land around the Proposed Action wells is largely in agricultural use, some residences and Pawnee National Grasslands receptors are located within the near-field area, as shown in Appendix C-2, Figure 1.

To account for the diversity of activities, equipment locations, and associated emissions during the development schedule, four scenarios were modeled: two for construction and development, one for construction and development with partial production, and one for full production. From these a combined average scenario was developed to reflect the timing and locations of activities during the oil and gas development (drilling, construction, etc.) phase. The full production scenario was used to represent the operation phase of the project. See Appendix C-2 for details of the scenario development, modeling assessment, and results.

[2] Receptors are point locations at which pollutant concentrations are calculated in the modeling. A receptor may represent any land use or facility that is of interest for purposes of air quality impacts.

Ambient concentrations were modeled for the criteria pollutants NO_2, PM_{10}, and $PM_{2.5}$, and the HAPs benzene, ethylbenzene, formaldehyde, n-hexane, toluene and xylene. Background levels (existing concentrations not due to the project) were accounted for using two components: a regional future projected background level based on data from the Colorado Air Resources Management Modeling Study (CARMMS) for criteria pollutants and recent year monitored concentrations for HAPs, and nearby existing emission sources. Concentrations due to the existing emissions sources located within the 12-kilometer modeling domain were estimated by directly including these sources in the modeling and calculating their contributions to total concentrations. The total concentration that is compared to the NAAQS equals the sum of the future projected background level, the level due to the existing nearby emissions sources, and the modeled impact due to the proposed project emissions.

As shown in Table 3-7, the NO_2 1-hour and $PM_{2.5}$ NAAQS are calculated using three consecutive years of monitored/modeled air pollutant concentrations to develop three-year average values. Multiple development/production phase modeling scenarios were defined based on applicant-provided construction/development schedule information. It was assumed that the proposed project-related activities and their emissions for each construction/development phase modeling scenario would not occur for more than one year. Three-year scenario average NO_2 and $PM_{2.5}$ concentrations were modeled for comparison to the NAAQS and are reported for the Development Phase in Table 3-7. The PM_{10} concentration for the Development Phase in Table 3-7 is the maximum concentration for any of the construction/development modeling scenarios. The Operation Phase modeled impacts are for the post-construction/development phase modeling scenario. The near-field modeling analysis predicted that total concentrations of criteria pollutants during the development and operations phases of the proposed project would be within the NAAQS, as shown in Table 3-7.

Table 3-7. Estimated Ambient Concentrations with the Proposed Action

Criteria Pollutant	Averaging Period	Concentration (µg/m³)			NAAQS (µg/m³)
		Modeled	*Background*	*Total*	
Development Phase (composite, modeling scenarios 1-4)					
NO_2	1 Hour	86.6	74.5	161.1	189
$PM_{2.5}$	24 Hours	4.8	11.4	16.2	35
	Annual	1.5	5.5	7.0	12
PM_{10}	24 Hours	58.5	31.5	90.0	150
Operation Phase (modeling scenario 4)					
NO_2	1 Hour	92.2	74.5	166.7	189
$PM_{2.5}$	24 Hours	4.4	11.4	15.8	35
	Annual	1.5	5.5	7.0	12
PM_{10}	24 Hours	46.4	31.5	77.9	150

[a] NR = Not Reported

For the total modeled concentrations shown in the table above, the future projected background concentrations for criteria pollutants may include some impact from the existing and proposed project-related sources because the CARMMS future year modeling included existing and future emissions sources and growth. To the extent this occurs the total predicted concentrations (values in "Total" column in Table 3-7) would include some double-counting between the background and modeled components. This would lead to more conservative (higher) estimates of total concentrations. As a result, actual criteria pollutant concentrations with the Proposed Action might be lower than predicted. See Appendix C-2 for more information regarding near-field air quality modeling analysis.

The HAPs analysis estimated that all short-term HAP concentrations would be less than the applicable Reference Exposure Levels, and all long-term HAP concentrations would be less than the applicable Reference Concentrations. Of the HAPs analyzed only benzene and formaldehyde are carcinogenic. Cancer risks for these compounds were analyzed using assumptions and methodology that are consistent with EPA guidance. The maximum estimated cancer risk occurred with Scenario 4 (production phase) and was estimated to be 2.7×10^{-5} (27 in a million)[3]. This cancer risk value falls within the range (10^{-6} to 10^{-4}) commonly used by the EPA and other agencies as criteria for acceptable risk (40 CFR 300.430(e)(2)(i)(A)(2)). See Appendix C-2 for details of the HAPs analysis.

The modeling analysis accounted for the following project-specific design features that were provided by the applicant. These equipment and practices would need to be implemented for the proposed action in order to protect future air quality in the project area:

- Operator would control fugitive emissions of particulate matter (dust) during construction and production phases, using procedures and control technology that would reduce dust emissions by at least 50 percent relative to uncontrolled conditions.
- The operator would use dual-fuel liquefied natural gas/natural gas drill rig engines (i.e., engines that can be fueled by liquefied natural gas [LNG] or diesel) that would be fueled by LNG and would meet 40 CFR Part 60 Subpart JJJJ.

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for other applicant-committed measures that are specific to development in the Project Area and would reduce impacts to air resources. The applicant would comply with Colorado Oil and Gas Commission (COGCC) Rule 805 which requires control of VOC emissions, odors, and fugitive dust. Noble would use supervisory control and data acquisition (SCADA) systems to monitor well operations, which would reduce emissions from vehicle traffic due to the reduced number of vehicle trips to the site.

In addition, the BLM expects that the operator would comply with all Colorado and federal regulations and requirements including COGCC Rule 805.b(3) for "green completions," NSPS OOOO and CDPHE Regulation 7 for oil and gas operations, and make every effort to minimize emissions through good engineering and operating practices to the maximum extent practical. These practices would help minimize the project's air quality impacts on the Denver/North Front Range ozone nonattainment area, reduce the HAP concentration levels in the proposed project area, and reduce overall GHG emissions associated with the proposed action.

Greenhouse Gas Emissions and Climate Change: According to the U.S. Global Change Research Program (2009), global warming is unequivocal, and the global warming that has occurred over the past 50 years is primarily human-caused. Specific thresholds of significance for GHG emissions have not been established by regulatory agencies. Predicting the degree of impact any single emitter of GHGs may have on global climate, or on the changes to biotic and abiotic systems that accompany climate change, is highly complex, has considerable uncertainty, and requires substantial computer modeling resources. This analysis is therefore limited to presenting project GHG emissions in context through comparisons to Colorado and national GHG emissions. The GHG emissions from the Proposed Action do not account for the ultimate use or consumption of any products generated by the project (i.e., life cycle GHG analysis)

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[3] The estimated cancer risk indicates the expected number of lifetime cancer deaths per million exposed population, based on the exposure assumptions used in the analysis.

because any additional processing and ultimate uses for the products is unknown. Section 3.5, Cumulative Impacts, provides a summary of information regarding expected changes to the global climatic system and empirical evidence of climate change that has occurred to date.

Table 3-8 compares the Proposed Action GHG emissions to Colorado and national emissions. Table 3-8 shows that the GHG contribution associated with the Proposed Action would be extremely small in this context.

Table 3-8. Greenhouse Gas Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 metric tons per year)	Proposed Action Percentage
Proposed Action (conservative maximum year: development/construction emissions plus one year of production emissions)	0.292	–
Colorado GHGs (2010)[a]	130	0.22%
Total U.S. GHGs (2013)[b]	6,673	4.4×10^{-5}%

[a] Source: CDPHE 2014.
[b] Source: EPA 2015d.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to air quality could be similar to those described for the Proposed Action.

Mitigation Measures

As described above, the maximum modeled air quality impacts for the proposed action are below the applicable standards and criteria for all pollutants. No additional mitigation measures would be required to offset impacts to air resources.

Residual Impacts

As described in the near-field modeling assessment above, the maximum modeled air quality impacts based on the proposed project design features are within applicable standards and criteria and therefore, no additional air quality protection measures would be required by the BLM for the proposed action. For this reason, a residual impacts analysis was not performed to show the benefits of additional (beyond project design features) air quality mitigation measures and the differences in air quality impacts with and without additional BLM-required mitigation measures.

3.2.2 Geologic and Mineral Resources

Affected Environment

Geology

The Project Area lies within the northern part of the DJ Basin commonly referred to as the Cheyenne Basin, which is a geologic structural basin located in northeastern Colorado extending into Wyoming, Nebraska, and western Kansas. The DJ Basin consists of a large syncline comprised of stratified Paleozoic and Mesozoic sedimentary rock layers. Cretaceous sandstones within the stratified sedimentary layers historically produced the majority of oil and natural gas resources in the DJ Basin; these were explored historically. The Niobrara Formation is a shale/marl/chalk/sandstone layer that is currently being explored and developed using horizontal drilling techniques. The DJ Basin aquifers occur within the upper formations of the DJ and provide water to millions of people in Colorado. Surficial geology of the Project Area is primarily composed of tertiary-aged sedimentary rocks in the Ogallala formation (Green 1992, NGI 2013).

Leasable Minerals

The proposed wells, pads, and associated infrastructure are located within northeastern Weld County in the DJ Basin, where the primary target is the Codell/Niobrara oil and gas. Most oil and gas in the DJ Basin has been historically produced from Cretaceous sandstones: J-Sandstone, Codell Sandstone, Niobrara Formation, Hygiene Sandstone, and Terry Sandstone (also known informally as the Sussex and Shannon Sandstones). According to COGCC data (2015), there are 35 oil and gas wells within a one-mile radius of the proposed well pad surface locations. Table 3-9 identifies the status of the 35 existing oil and gas wells as of February 11, 2015. In addition to these existing oil and gas wells, there are 13 active permitted locations, 12 of which Noble submitted.

Table 3-9. Existing Oil/Gas Wells within the Proposed Project Area

Well Status	Well Owner/Operator		Total Wells
	Noble	***Other***	
Producing Oil or Gas (PR)	14	3	17
Drilling (DR)	1	2	3
Temporarily Abandoned (TA)	0	2	2
Abandoned Location (AL)	4	2	6
Drilled and Abandoned (DA)	0	5	5
Plugged and Abandoned (PA)	0	2	2
TOTAL	**19**	**16**	**35**

Source: COGCC 2015a

Locatable and Salable Minerals

In addition to oil and gas, uranium and coal resources are also found in Weld County. Uranium resources are found in the Fox Hills and Laramie Formations, primarily north of Greeley and west of Keota, outside of the Project Area. Coal resources are found throughout the DJ Basin in the Laramie Formation and the Denver Formation. However, the approximate extent of coal-bearing rocks in the

Laramie and Denver Formations primarily occur west of the Project Area, in the west half of Weld County (Roberts 2007). Sand and gravel resources are also located throughout Weld County. According to the Colorado Division of Reclamation Mining and Safety (CDRMS). No sand and gravel pits are present within the Project Area; however, 23 permits for sand and gravel pits occur within 10 miles of the Project Area. In addition, there is one permit for a uranium mine and two permits for clay pits within 10 miles of the Project Area (CDRMS 2013).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

The Proposed Action would result in approximately 305 acres of surface disturbance on private surface land (3.8 percent of the Project Area), which would be reclaimed to a total long-term disturbance of approximately 141 acres (or 1.8 percent of the Project Area) for the life of the project until facilities are decommissioned and removed, and final reclamation is complete. Direct impacts on geology would include alterations to existing topography from grading/surface leveling activities during the construction of well pads and associated infrastructure (including roads, pipelines, and centralized production facilities). Indirect impacts may occur through the natural weathering of disturbed areas and slope and drainage alterations.

If the proposed project plans to utilize federal minerals in the construction of roads, well pads, or for any other construction needs, then compliance with 43 CFR 3600 is required. The proponent would need to submit an application for mineral materials disposal with the BLM, prior to any disturbance being initiated. Federal mineral materials regulations also apply to split estate (i.e., a private surface landowner could not dispose of federal mineral materials for this project, surface or subsurface, without prior authorization from the BLM).

The recovery of oil and gas resources under the Proposed Action would reduce the volume of recoverable reserves from the Codell/Niobrara formation, and possibly other formations underlying the Project Area. Oil and gas resources recovered under the Proposed Action would provide an energy resource that would generate both public and private revenues.

Subsurface uranium deposits west of the Project Area are associated with Fox Hills and Laramie Formation sandstones. With proper well casing and cementing, the Proposed Action would be unlikely to result in the comingling of produced water and uranium-bearing waters in this formation. The Proposed Action is not anticipated to affect future uranium mining operations; no uranium mining operations are known to be planned within or adjacent to the Project Area.

No commercial coal mining has occurred in the DJ Basin for more than 20 years (Roberts 2007).

Although there are no known sand or gravel pits in the Project Area, the construction of roads, well pads, and other ancillary facilities associated with the Proposed Action would increase the demand for salable minerals (e.g., sand and gravel) in or near the Project Area. The removal of sand and gravel will not have a measurable impact in the vicinity because the resource is so plentiful in the area.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to geologic and mineral resources could be similar to those described for the Proposed Action depending on the depth of the federal minerals avoided. Not developing the federal minerals from this project could result in a situation in which reservoirs are not adequately developed, and federal minerals could be drained by nearby private wells, potentially making the small parcels of federal minerals uneconomic to develop by themselves in the future. Drainage cases commonly occur in northeastern Colorado, where land and mineral ownership patterns are complex.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to geologic and mineral resources.

3.2.3 Prime and Unique Farmlands

Affected Environment

Prime farmland is defined by the U.S. Department of Agriculture (USDA) as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses (USDA NRCS 2015a). Unique farmland consists of lands other than prime farmland utilized for the production of specific high-value food and fiber crops, including citrus, tree nuts, olives, cranberries, and other fruits and vegetables. Other areas that do not meet the criteria for prime or unique farmland but determined by the appropriate state agencies to be considered important for the production of food, feed, fiber, forage, and oilseed crops are delineated as farmlands of statewide importance (USDA NRCS 2015a).

The BLM used the USDA National Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) dataset (USDA NRCS 2014) to determine the presence of prime farmland and farmland of statewide importance within the Project Area. Four soil units totaling approximately 1,066 acres of prime farmland (if irrigated) occur in the Project Area; however, none of these lands are irrigated so they are not effectively prime farmland. Five soil units totaling approximately 3,188 acres of farmland of statewide importance overlap the Project Area (Table 3-10). No soil units in the Project Area are identified as unique farmlands.

Table 3-10. Prime Farmland and Farmland of Statewide Importance in the Project Area

Farmland Classification	Soil Unit Name	Acres in Project Area[1]
Prime Farmland (if irrigated)	Keith loam, 0 to 6 percent slopes	935.7
	Nunn clay loam, 0 to 6 percent slopes	31.7
	Nunn loam, 0 to 6 percent slopes	12.5
	Haverson loam, 0 to 3 percent slopes	86.0
Farmland of Statewide Importance	Ascalon fine sandy loam, 0 to 6 percent slopes	252.8
	Kim-Mitchell complex, 0 to 6 percent slopes	2,664.3
	Manter sandy loam, 0 to 6 percent slopes	10.4
	Olney fine sandy loam, 0 to 6 percent slopes	0.6
	Stoneham fine sandy loam, 0 to 6 percent slope	260.3

Source: USDA NRCS 2014

[1]Acreages rounded to the nearest 0.1 acre

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Direct, adverse impacts to prime farmland are not anticipated to result from development of the Proposed Action because none of the land within the Project Area is currently irrigated for the production of food, feed, forage, fiber, and oilseed crops. However, surface disturbance from new well pads, access roads, production facilities, and pipelines would result in approximately 226.6 acres of initial surface disturbance of farmland of statewide importance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 104.2 acres to farmland of statewide importance.

Grading, leveling, and removal of vegetation and soil would be the primary sources of surface disturbance associated with construction of the proposed well pads and associated infrastructure. In general, potential direct impacts to farmland of statewide importance resulting from new surface disturbance and project-related activities would be similar to those discussed in Section 3.2.4 Soil Resources. Long-term disturbance would result in the loss of approximately 104.2 acres of farmland of statewide importance until the project is decommissioned and wells are plugged and abandoned, at which time all land disturbed for the project would again be available to agricultural production.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to prime and unique farmlands could be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to prime and unique farmlands.

3.2.4 Soil Resources

Affected Environment

The BLM used the USDA NRCS Soil Survey Geographic (SSURGO) dataset (USDA NRCS 2014) to determine soil mapping units and soil characteristics of the Project Area. SSURGO is the most detailed level of soil mapping performed by the NRCS, which applies national standards and field mapping methods to construct the soil maps in the SSURGO database. According to the SSURGO database for northern Weld County, the Project Area is underlain by 22 unique soil mapping units. Table 3-11 lists the soil units underlying the Project Area along with the runoff and water erosion potential for each soil unit as identified by the USDA NRCS (USDA NRCS 2014; USDA 1982).

Table 3-11. Dominant or Important Soils within the Project Area

Soil Unit Name	Runoff Potential	Water Erosion Potential[1]	Percent of Project Area[2]
Altvan fine sandy loam, 6 to 9 percent slopes	Medium	High	<1
Argiustolls-Rock outcrop complex, 0 to 9 percent slopes	Medium to Rapid	Slight to High	<1
Ascalon fine sandy loam, 0 to 6 percent slopes	Slow to Medium	Slight to Moderate	1.7
Ascalon fine sandy loam, 6 to 9 percent slopes	Medium to Rapid	High	<1
Badland	Very High	Very High	2.1
Bushman fine sandy loam, 3 to 9 percent slopes	Medium	Moderate to High	1.4
Cascajo gravelly sandy loam, 5 to 20 percent slopes	Medium	Moderate to Very High	<1
Epping silt loam, 0 to 9 percent slopes	Medium	Slight to Very High	15.6
Haplaquolls-Fluvaquents complex, frequently flooded	Slow	Slight	<1
Haverson loam, 0 to 3 percent slopes	Slow to Medium	Slight	1.4
Keith loam, 0 to 6 percent slopes	Slow	Slight to Moderate	9
Kim-Mitchell complex, 0 to 6 percent slopes	Medium to Rapid	Slight to Moderate	39.4
Kim-Mitchell complex, 6 to 9 percent slopes	Medium to Rapid	High	<1
Kim-Shingle complex, 6 to 30 percent slopes	Medium to Rapid	High to Very High	3.8
Manter sandy loam, 3 to 9 percent slopes	Slow	Slight to Moderate	<1
Olney fine sandy loam, 0 to 6 percent slopes	Slow to Medium	Slight to Moderate	<1
Otero sandy loam, 0 to 3 percent slopes	Slow	Slight	1.9
Otero sandy loam, 3 to 9 percent slopes	Medium	Moderate to High	8.7
Otero-Tassel complex, 6 to 30 percent slopes	Slow	High	1.5
Peetz gravelly sandy loam, 5 to 20 percent slopes	Medium	High to Very High	2.3
Shingle clay loam, 0 to 9 percent slopes	Medium to Rapid	Slight to Very High	1.9
Stoneham fine sandy loam, 0 to 6 percent slopes	Rapid	Slight to Moderate	3.9
Stoneham fine sandy loam, 6 to 9 percent slopes	Rapid	High	2.3
Thedalund-Keota loams, 3 to 9 percent slopes	Medium	Moderate to High	<1

Sources: USDA NRCS 2014; USDA 1982

[1]The potential for wind erosion is slight to moderate for all soil units in the Project Area.
[2]Total may not equal 100 due to rounding.

In general, the dominant soil units in the Project Area where proposed well pads and infrastructure would be developed (the Epping, Keith, Kim-Mitchell, Otero, and Stoneham series) consist of shallow to deep, well drained, permeable soils that formed in calcareous loamy residuum, colluvium, and alluvium (USDA 1982). Collectively, these soils comprise approximately 77 percent of the Project Area. Additional descriptions for these soils are provided below.

The Epping silt loam, 0 to 6 percent slopes (15.6 percent of the Project Area), is found on dissected plains of the Project Area. Included in this unit are small areas of Keota loam, Kim loam, Mitchell silt loam, and Thedalund loam. The potential plant community on this unit is mainly blue grama (*Bouteloua gracilis*), winterfat (*Krascheninnikovia lanata*), western wheatgrass (*Pascopyrum smithii*), and fourwing saltbush (*Atriplex canescens*). Runoff on this soil unit is medium and the hazard of water erosion ranges from slight to very high (USDA 1982).

The Keith loam, 0 to 6 percent slopes (9 percent of the Project Area), is found on slightly dissected plains and alluvial fans of the Project Area. Included in this unit are small areas of Mitchell silt loam, Kim loam, Wages fine sandy loam, and Weld loam. The potential plant community on this unit is mainly blue grama, western wheatgrass, sedges (*Carex spp.*), and buffalograss (*B. dactyloides*). Runoff on this soil unit is slow and the hazard of water erosion ranges from slight to moderate (USDA 1982).

The Kim-Mitchell complex, 0 to 6 percent slopes (39.4 percent of the Project Area), is found on dissected plains, swales, and on stream terraces of the Project Area. This unit is about 45 percent Kim loam and 40 percent Mitchell silt loam. Included in this unit are small areas of Haverson, Thedalund, and Keota loams. The potential plant community on the Kim soil is mainly blue grama, western wheatgrass, sedges, and buffalograss. The potential plant community on the Mitchell soil is mainly blue grama, western wheatgrass, and fourwing saltbush. Runoff on this complex ranges from slow to rapid, while the hazard of water erosion ranges from slight to moderate (USDA 1982).

Otero sandy loam, 3 to 9 percent slopes (8.7 percent of the Project Area), is found on moderately to highly dissected plains and fans of the Project Area. Included in this unit are small areas of Stoneham fine sandy loam, soils that have a gravelly surface layer or gravelly underlying material, Kim and Mitchell soils, Bushman fine sandy loam, and soils that have slopes of less than 3 percent. The potential plant community on this unit is mainly blue grama, prairie sandreed (*Calamovilfa longifolia*), and needle and thread (*Hesperostipa comata*). Runoff on this soil unit is medium and the hazard of water erosion ranges from moderate to high (USDA 1982).

Stoneham fine sandy loam, 0 to 6 percent slopes (3.9 percent of the Project Area), is found on moderately dissected plains and alluvial fans of the Project Area. Included in this unit are small areas of Kim and Mitchell soils, comprising approximately 15 percent of this unit. The potential plant community on this unit is mainly blue grama, wheatgrass, sedges, and buffalograss. Runoff on this soil unit is rapid and the hazard of water erosion ranges from slight to moderate (USDA 1982).

Playas

The BLM reviewed U.S. Geologic Survey (USGS) topographic mapping and aerial imagery (3- and 10-meter elevations) to determine the potential presence of playas within the Project Area, which are depressions that hold shallow amounts of surface water following heavy precipitation events. In some playas, standing water can remain for long periods because playas often do not have outlets. Review of USGS topographic mapping and aerial imagery identified one 2.85-acre playa in the southwest quarter of Section 13.

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and would reduce impacts to soil resources.

Surface disturbance from new well pads, access roads, production facilities, and pipelines would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres, including re-contouring and seeding/re-planting. Table 3-12 provides the estimated acreage of short-term surface disturbance by soil unit in the Project Area. An estimated 57.6 acres of initial surface disturbance and 25.9 acres of long term disturbance would occur on soils with a high to very high water erosion potential and an estimated 229.7 acres of initial disturbance and 113.6 acres of long term disturbance would occur on soils with slight to moderate water erosion potential. Following final well plugging, all facilities and surfacing materials would be removed and all road and pad areas would be re-contoured and reseeded.

Grading, leveling, and removal of vegetation and soil would be the primary sources of surface disturbance associated with construction of the proposed well pads and associated infrastructure. Potential direct impacts on soils resulting from new surface disturbance and project-related activities would include soil rutting and mixing, compaction, increased erosion potential, and the loss of soil productivity. Soil rutting can affect surface hydrology and drainage patterns, as well as the rooting environment. Rutting can also result in mixing of topsoil and subsoil, which can reduce soil productivity. In addition, the diversion and concentration of surface flows resulting from soil rutting could accelerate erosion, especially on soils with high water erosion potential. Soil compaction can lead to a loss of soil structure, decreased infiltration and permeability, decreased soil productivity, and an increase of runoff and erosion potential.

Potential indirect impacts would include increased potential for gullies, generation of sedimentation, and disruption and interception of subsurface flow of water that could alter soil moisture regimes. Adverse impacts to soils would most likely occur on disturbed soils with high to very high water erosion potential and high susceptibility to wind erosion (Table 3-12). None of the proposed project components would directly impact playa habitat; however, construction activities occurring adjacent to the playa in Section 13 could result in erosion and the transport sediment to the playa and degrade habitat while also reducing water storage capacity. Adverse impacts to playa habitats would be minimized or eliminated through the implementation of BMPs for erosion and sediment control contained within the Field Wide Stormwater Management Plan for Construction Activities (Noble 2015b). These BMPs include, but are not limited to check dams, earth berms, culvert protection, slope drains, rock-lined ditches, mulches, geotextiles, and erosion control blanketing.

Table 3-12. Surface Disturbance by Soil Unit for the Proposed Action

Soil Unit Name	Runoff Potential	Water Erosion Potential	Proposed Action Surface Disturbance (acres)
Altvan fine sandy loam, 6 to 9 percent slopes	Medium	High	0
Argiustolls-Rock outcrop complex, 0 to 9 percent slopes	Medium to Rapid	Slight to High	0.76
Ascalon fine sandy loam, 0 to 6 percent slopes	Slow to Medium	Slight to Moderate	5.07
Ascalon fine sandy loam, 6 to 9 percent slopes	Medium to Rapid	High	2.05
Badland	Very High	Very High	0
Bushman fine sandy loam, 3 to 9 percent slopes	Medium	Moderate to High	0
Cascajo gravelly sandy loam, 5 to 20 percent slopes	Medium	Moderate to Very High	0
Epping silt loam, 0 to 9 percent slopes	Medium	Slight to Very High	42.55
Haplaquolls-Fluvaquents complex, frequently flooded	Slow	Slight	0
Haverson loam, 0 to 3 percent slopes	Slow to Medium	Slight	0
Keith loam, 0 to 6 percent slopes	Slow	Slight to Moderate	13.3
Kim-Mitchell complex, 0 to 6 percent slopes	Medium to Rapid	Slight to Moderate	197.77
Kim-Mitchell complex, 6 to 9 percent slopes	Medium to Rapid	High	0.28
Kim-Shingle complex, 6 to 30 percent slopes	Medium to Rapid	High to Very High	0
Manter sandy loam, 3 to 9 percent slopes	Slow	Slight to Moderate	0
Olney fine sandy loam, 0 to 6 percent slopes	Slow to Medium	Slight to Moderate	0
Otero sandy loam, 0 to 3 percent slopes	Slow	Slight	2.87
Otero sandy loam, 3 to 9 percent slopes	Medium	Moderate to High	0
Otero-Tassel complex, 6 to 30 percent slopes	Slow	High	0.09
Peetz gravelly sandy loam, 5 to 20 percent slopes	Medium	High to Very High	2.4
Shingle clay loam, 0 to 9 percent slopes	Medium to Rapid	Slight to Very High	2.34
Stoneham fine sandy loam, 0 to 6 percent slopes	Rapid	Slight to Moderate	13.6
Stoneham fine sandy loam, 6 to 9 percent slopes	Rapid	High	7.87
Thedalund-Keota loams, 3 to 9 percent slopes	Medium	Moderate to High	0
TOTAL	-	-	**290.96[2]**

Sources: USDA NRCS 2014; USDA 1982

[1]The potential for wind erosion is slight to moderate for all soil units in the Project Area.
[2]Totals may not add up due to rounding differences between soil calculations and surface disturbance calculations.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to soil resources could be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to soil resources.

3.2.5 Water Resources (Surface and Groundwater)

Affected Environment

Surface Water Resources

The Project Area is situated within portions of two hydrologic unit code (HUC)-10-digit watersheds: the South Pawnee Creek Watershed (HUC 109001402) and the North Pawnee Creek Watershed (HUC 109001401), which are within the Pawnee Watershed (HUC 10190014) of the South Platte River Basin (USGS 2015b) (Figure 3-5). Land use in the region is primarily agricultural (including rangeland). The Project Area is drained by Igo Creek and an unnamed intermittent stream which ultimately drain to Pawnee Creek, a tributary to the South Platte River. Spring Creek is the nearest perennial waterbody to the Project Area and is located approximately 22 miles north-northwest of the Project Area (USGS 2015b).

Review of the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping identified several freshwater emergent wetland areas in the Project Area; however, no wetland vegetation or other wetland indicators were observed during survey efforts (SWCA 2014b). Intermittent streams in the Project Area generally occur in uplands areas, are normally dry, and are likely to only convey water flow during and after storm events. Due to the relatively low level of annual precipitation in the Project Area (approximately 15 inches per year on average), water flows in the intermittent drainages are likely infrequent (WRCC 2015).

Primary factors affecting surface water quality in and near the Project Area are expected to be runoff events containing appreciable sediments and salts. Runoff tends to accumulate salt and sediment from surface soils and transport the sediment into main drainages during intense localized storm events. An estimated 300 acres of existing disturbance including roads, pipelines, well pads and other facilities is present within the Project Area.

Groundwater Resources

The Project Area is underlain by the Dakota-Cheyenne Aquifer and the High Plains Aquifer. The Dakota Sandstone and Cheyenne Sandstone Members have a saturated thickness of greater than 150 feet and between 30 to 200 feet, respectively and are part of the Cretaceous Dakota Sandstone and Purgatoire Formation stratigraphic units (Colorado Geological Survey 2003). The Colorado Geological Survey (2003) describes the yields of the Dakota Sandstone as sufficient for domestic and stock use, and, in some areas, yields are sufficient for municipal and industrial use. The yields for the Cheyenne Sandstone Member are described as sufficient for industrial, municipal, and irrigation use. The Dakota Group ranges in thickness from less than 100 feet in the southwest of Colorado to over 500 feet in the northeast of Colorado (Colorado Geological Survey 2003).

This High Plains Aquifer is an extensive regional aquifer of significant economic importance as it provides groundwater to approximately 20 percent of the irrigated cropland in the U.S. (Colorado Geological Survey 2003). The High Plains Aquifer is composed primarily of the unconsolidated to semi-consolidated sands, gravels, clays, and silts of the Miocene-aged Ogallala Formation with a saturated thickness ranging from zero to greater than 250 feet (Colorado Geological Survey 2003). Well yields range from less than 25 gallons per minute (gpm) to more than 1,000 gpm; wells reporting yields of less than 25 gpm typically represent domestic and stock use, while yields greater than 500 gpm represent irrigation use. Discharge typically exceeds recharge in the High Plains Aquifer, with the primary source of discharge being ground-water extraction for agricultural purposes (Colorado Geological Survey 2003).

Water quality within the Dakota-Cheyenne and High Plains aquifers is generally good, with reported total dissolved solid (TDS) concentrations ranging from 200 to 25,000 milligrams per liter (mg/L) in the Dakota-Cheyenne Aquifer and 100 to 600 mg/L in the High Plains Aquifer. In the Dakota-Cheyenne Aquifer, higher TDS concentrations are typically associated with oil and gas fields and the water chemistry is highly variable due to the complex stratigraphy in the northern portion of the aquifer (Colorado Geological Survey 2003). Tests from existing wells in the Project Area indicate that water in the Upper Pierre Formation is not potable due to levels of sulfate and chloride that do not meet the EPA's recommended levels for potable water, as well as bicarbonate, TDS, and some metals (eAnalytics Laboratories 2013).

TDS concentrations in many potions of the High Plains Aquifer have risen considerably since the early 1900s and may be the result of agricultural irrigation recharge and evaporative concentration. Naturally occurring concentrations of sulfate, chloride, fluoride, and irons sometimes exceed federal and state drinking water standards and may be derived from underlying rock formations or from ash lenses within the High Plains Aquifer (Colorado Geological Survey 2003). Similarly, arsenic concentrations are elevated in some areas of the High Plains Aquifer in northern Colorado and may be naturally derived from associated rocks or may have been introduced by older pesticides containing arsenic compounds (Colorado Geological Survey 2003).

Existing and proposed water wells in the Project Area target the Laramie-Fox Hills and Upper Pierre Formations. The Laramie-Fox Hills Aquifer consists of approximately 400 feet of clay shales with minor interbeds of sandstone and siltstone, underlies approximately 6,700 square miles, and marks the areal extent of the DJ Basin for economic groundwater development (Pottorff 2012). The Pierre Shale underlies the Fox Formation and is composed of up to 4,500 feet of clay shale with minor sandstone units (Pottorff 2012).

Figure 3-6 shows that there are 24 existing water wells within a one-mile radius of the proposed well pads (Colorado Division of Water Resources 2013). Table 3-13 provides water well information for existing water wells within a one-mile radius of proposed well pads. Total depths for these existing water wells ranges from 15 feet below ground surface (bgs) to 1,630 feet bgs. Permitted uses include stock watering, irrigation, domestic, industrial, and commercial applications.

Table 3-13. Water Supply Wells within the Project Area

Permit Number	Location				Permitted Use	Well Depth (ft bgs)	Static Water Level (ft)	Targeted Aquifer(s)
	Township	*Range*	*Section*	*Qtr-Qtr*				
292031	9N	59W	10	SWSE	Other	Unknown	Unknown	All unnamed aquifers
77932	9N	59W	10	SWSE	Industrial/Irrigation	1,630	733	All unnamed aquifers
271978	9N	59W	11	NENW	Domestic	100	33	All unnamed aquifers
347	9N	59W	11	SENE	Stock	68	Unknown	All unnamed aquifers
290513	9N	59W	11	SWSE	Other	1,550	682	Laramie Fox Hills
78058	9N	59W	11	SWSE	Industrial/Irrigation	Unknown	665	All unnamed aquifers
279739	9N	59W	12	NWSE	Stock	50	Unknown	All unnamed aquifers
296694	9N	59W	12	SESW	Other	Unknown	Unknown	All unnamed aquifers
290143	9N	59W	12	SWNW	Other	418	60	Laramie Fox Hills
290144	9N	59W	12	SWNW	Other	340	135	Laramie Fox Hills
37155	9N	59W	14	SESE	Stock	125	87	All unnamed aquifers
5048	9N	59W	14	SWSW	Stock	300	145	All unnamed aquifers
12	9N	59W	15	--	Unknown	320	Unknown	All unnamed aquifers
283735	9N	59W	15	SWNW	Domestic/Stock	250	Unknown	All unnamed aquifers
20992	9N	59W	21	SWNW	Stock	225	140	All unnamed aquifers
96110	9N	59W	22	NESW	Domestic/Stock	155	65	All unnamed aquifers
283730	9N	59W	22	SENW	Stock	15	Unknown	All unnamed aquifers
296656	9N	59W	2	SESE	Commercial	Unknown	Unknown	All unnamed aquifers
271977	9N	59W	2	SESW	Domestic	Unknown	Unknown	All unnamed aquifers
278757	9N	59W	2	SWSE	Domestic/Stock	100	38	All unnamed aquifers
Unknown	9N	59W	16	SWSW	Domestic/Stock	100	Unknown	All unnamed aquifers
157213	9N	59W	28	NENE	Stock	229	70	Laramie Fox Hills
284137	9N	59W	28	NESE	Stock	Unknown	Unknown	All unnamed aquifers
77594	9N	59W	28	NESW	Domestic/Stock	139	90	All unnamed aquifers

Source: CDWR 2013

ft feet
ft bgs feet below ground surface
Qtr quarter

Figure 3-5. Watersheds

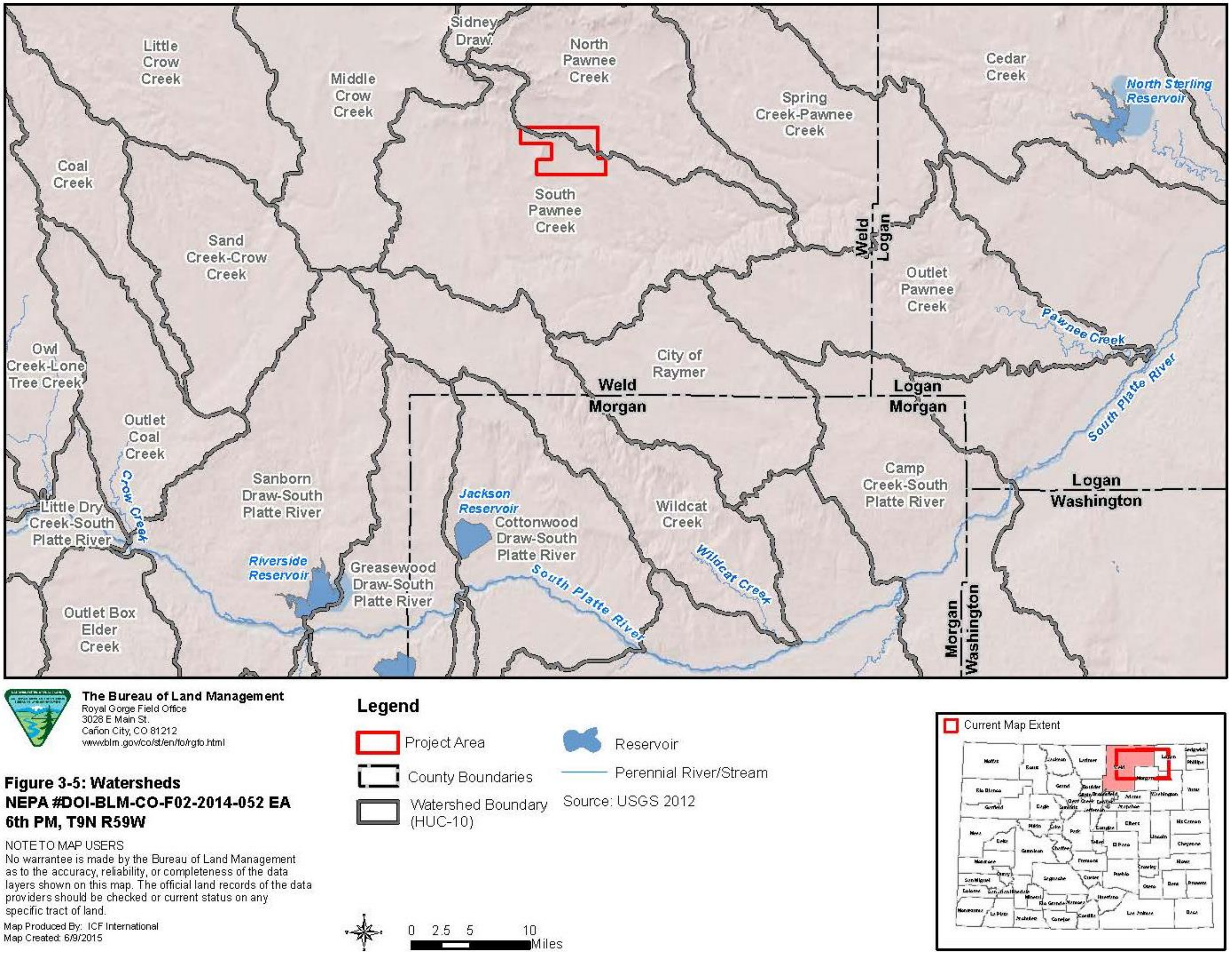
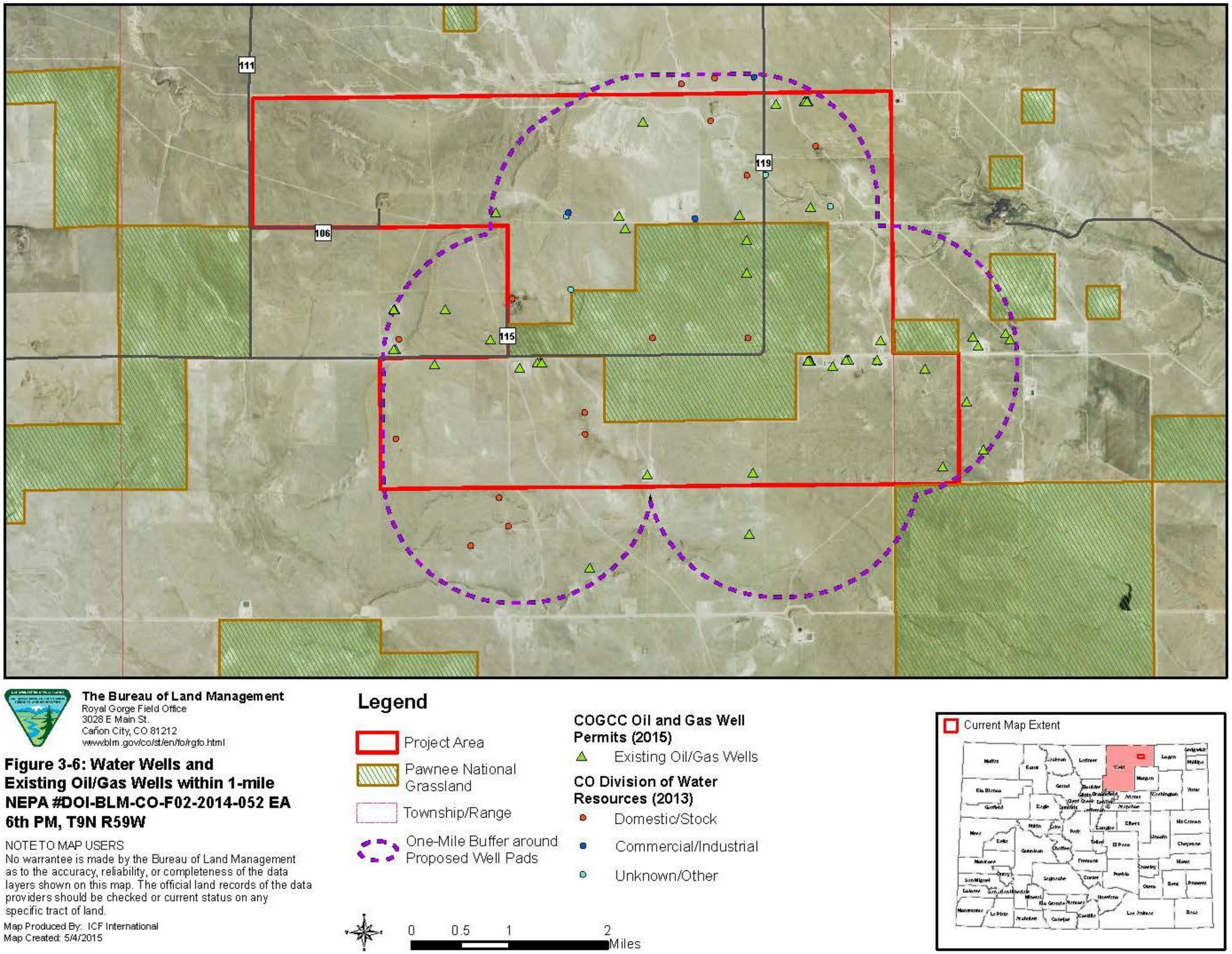


Figure 3-6. Water Wells and Existing Oil/Gas Wells



Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Noble would design water recycling capabilities at mobile treatment units to recycle and re-use up to 50 percent of the water by-products. This measure along with other applicant-committed measures specific to development in the Project Area (Refer to Section 2.2.1.11 Design Mitigation Features) would reduce impacts to water resources.

Construction of the proposed well pads, EcoNodes, access roads, and pipelines would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. Although there are no perennial streams located within the Project Area, surface disturbance could result in adverse impacts to hydrology and water quality by increasing channelization, erosion, sedimentation, and salinity in intermittent drainages in the Project Area. The Proposed Action would require crossing of North Pawnee Creek, which lacks a defined channel with an ordinary high water mark; however, this drainage may be found jurisdictional due to its hydrologic connectivity with downstream jurisdictional reaches (SWCA 2014b).

Due to the relatively flat topography of the Project Area and its distance from perennial waterbodies, impacts to hydrology and surface water quality are anticipated to be minimal. In addition, the implementation of BMPs for erosion and sediment control contained within the Field Wide Stormwater Management Plan for Construction Activities (Noble 2015b) would further reduce the potential for adverse impacts to hydrology and water quality. These BMPs include, but are not limited to check dams, earth berms, culvert protection, slope drains, rock-lined ditches, mulches, geotextiles, and erosion control blanketing.

The potential for impacts to surface waters from chemicals or other hazardous substances accidentally spilled or leaked during construction and operation of the Proposed Action is anticipated to be minimal due to the distance of the Project Area to perennial waterbodies. Federal and state regulations, along with the implementation of a Spill Prevention, Control, and Countermeasure Plan (Noble 2012) would further reduce the potential for accidental discharge of oil or other substances into surface waters.

The Proposed Action would require up to approximately 1,245 ac-ft of water for drilling, completion, dust abatement, and hydrostatic testing (Table 2-2). This water supply would come from four existing and one proposed private water supply wells; no surface water would be used to support the Proposed Action. Of the 1,200 ac-ft of water used during completions activities, an estimated 480 ac-ft would flow back to the surface and be captured in enclosed, covered, or netted and screened temporary on-site storage tanks. Approximately 240 ac-ft of water would be treated and reused in subsequent hydraulic fracturing operations. The remaining produced water would be transported offsite for disposal in UIC wells managed by a third party.

Withdrawal of up to approximately 1,245 ac-ft of groundwater would be a permanent removal of water from the Upper Pierre and Laramie-Fox Hills aquifers because it would not be returned to the aquifers and would result in a permanent reduction of available water in the aquifers. As water is withdrawn from the existing and proposed water supply wells, the water table would drop and the depth to groundwater would increase in the area immediately around the well. Groundwater drawdown in the aquifers would be greatest at the extraction well location and decrease with distance from the well.

This project falls under BLM Colorado's Programmatic Biological Assessment (PBA) for water depleting activities associated with BLM's fluid minerals program in the Platte River Basin in Colorado (BLM

2015a). Refer to Section 3.3.6 Threatened, Endangered, and Candidate Species for additional discussion of the PBA in relation to proposed water depleting activities.

The Proposed Action would drill through the Laramie-Fox Hills Aquifer to produce hydrocarbons from underlying formations. Drilling the proposed wells would pass through usable groundwater. Groundwater in this area is relied on for agricultural and domestic use. Potential impacts to groundwater resources could occur if proper cementing and casing programs are not followed. This could include loss of well integrity, surface spills, or loss of fluids in the drilling and completion process. Chemical additives used in drilling activities can be introduced into the water producing formations without proper casing and cementing of the wellbore. A closed loop drilling mud system, and the use of water based mud would prevent any shallow groundwater contamination.

During the APD stage, geologic and engineering reviews will be completed to ensure that cementing and casing programs are adequate to protect all downhole resources. Drilling in this part of the DJ Basin is very common and predictable, and the geology in the area is well known. Known water bearing zones in the Project Area are protected by drilling requirements and, with adherence to federal and state regulations and proper practices, contamination of ground water resources is unlikely. Casing, along with cement, would be extended beyond fresh-water zones to ensure that drilling fluids remain within the well bore.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to water resources could be similar to those described for the Proposed Action depending on the depth of the federal minerals avoided.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to water resources.

3.3 Biological Resources

3.3.1 Vegetation

Affected Environment

The project is located within the Colorado Piedmont of the Great Plains Physiographic Province. The proposed well pads and facilities are located in an area with sparse vegetation at approximately 5,000 feet (1,500 meters [m]) above mean sea level. The dominant vegetation community type around the Project Area is Western Great Plains Shortgrass Prairie which includes the following species: grama grass (*Bouteloua spp.*), buffalograss, needle and thread (*Hesperostipa comata*), prairie junegrass (*Koeleria macrantha*), western wheatgrass, purple three-awn (*Aristida purpurea*), and sand dropseed (*Sporobolus cryptandrus*). Common trees and shrubs observed in the Project Area include Siberian elm (*Ulmus pumila*), boxelder (*Acer negundo*), sand sagebrush (*Artemisia filifolia*), field sagewort (*Artemisia borealis*), and white sagebrush (*Artemisia ludoviciana*) (Walsh 2013c, SWCA 2014a). Table 3-14 provides a list of the National Gap Analysis Program (GAP) landcover classes found in the Project Area. The majority of the Project Area is grassland and cultivated cropland vegetation.

Table 3-14. Vegetation Cover Types in the Project Area

Vegetation Type	Acres in the Project Area	Percentage of Project Area
Western Great Plains Shortgrass Prairie	7,208	90.3
Cultivated Cropland	652	8.2
Western Great Plains Cliff and Outcrop	68	0.9
Developed, High Intensity	26	0.3
Western Great Plains Foothill and Piedmont Grassland	18	0.2
Western Great Plains Sandhill Steppe	12	0.2
Introduced Upland Vegetation – Annual Grassland	2	0.02

Source: USGS 2011

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and would reduce impacts to vegetation.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. Portions of the Project Area (approximately 300 acres) and its surrounding landscape have been previously developed for oil and gas resources. The private lands on which the well pads, EcoNodes, and associated infrastructure and facilities are proposed are supported by various existing infrastructures including roads, pipelines, and water wells.

Direct impacts to vegetation would primarily be associated with clearing of vegetation during the construction phase and degradation of habitat through soil compaction and loss of topsoil. Indirect impacts to vegetation resources may include the invasion and establishment of invasive plants; however, these impacts would be mitigated by implementation of an integrated weed management plan (Noble 2015b).

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to vegetation could be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to vegetation.

3.3.2 Invasive Plants

Affected Environment

Noxious weeds are non-native invasive plants that displace desirable vegetation and degrade natural and agricultural lands. In Colorado, they threaten water supply, agricultural crops, rangelands and native habitats. The Colorado Noxious Weed Act of 1990 (35-5.5 CRS) enables county and city governments to implement management programs aimed at noxious weeds. The Colorado Department of Agriculture maintains a list of noxious weeds which is posted to the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) plants database (USDA NRCS 2015b). The Weld County Department of Public Works manages noxious weeds in Weld County. Weld County organizes weeds species into three categories (Weld County 2015b):

- List A – Eradication Weed Species: Plants on this list either are not in Colorado yet or are present in very limited numbers and eradication of these species is still possible.
- List B – Control Weed Species: Plants on this list are typically already established in Colorado or may just be moving into Weld County.
- List C – Suppression Weed Species: Plants on this list are typically already heavily established in Colorado and Weld County.

There are approximately 1.8 acres of non-native annual grassland in the Project Area (USGS 2011) (Table 3-14). During an onsite visit, consultants identified cheat grass (*Bromus tectorum*), common mullein (*Verbascum thapsus*), and halogeton (*Halogeton glomeratus*) in the Project Area, which are all List C species. One other weed species identified that is not on the Weld County noxious weed list is Russian thistle (*Salsola spp.*).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts due to the spread of invasive plants.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. The private lands on which the well pads, EcoNodes, and associated infrastructure and facilities are proposed are supported by various existing infrastructures including roads, pipelines, and water wells. In addition, the Project Area has historically been used for dryland farming and livestock grazing, which have also contributed to the presence of invasive plants. As a result, the Project Area has been exposed to invasive plants due to previous disturbances and impacts are expected to be minor. The extent and severity of invasive plant expansion would depend on the success of reclamation and revegetation and the degree and success of invasive plant control efforts.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to invasive plants could be similar to those described for the Proposed Action.

<u>*Protective/Mitigation Measures*</u>

No additional mitigation measures would be required to offset impacts from invasive plants.

3.3.3 Terrestrial Wildlife

Affected Environment

The private lands on which the project is proposed are used for livestock grazing, agriculture, and oil and gas development, and the predominant habitat is Western Great Plains Shortgrass Prairie (SWCA 2014a). Wildlife species in the area is limited to those that have acclimated to the increased human development activity in the area and includes big game species, raptors, various small mammals and carnivores, bats, and reptiles. There is no suitable habitat for aquatic species in the Project Area.

Big Game

The Project Area is located in CPW's Game Management Unit (GMU) 88. There are no public access properties within this GMU. Data Analysis Unit (DAU) D-5 for mule deer overlaps the Project Area. CPW-designated mule deer severe winter range/winter range, and winter concentration area overlaps 3,249 acres (40.7 percent) and 2,094 acres (26.2 percent) of the Project Area respectively. The Project Area is within DAU A-1 for pronghorn antelope; however, no CPW-designated pronghorn ranges overlap the Project Area. Pronghorn winter ranges is located approximately three miles south of the Project Area (CPW 2014). In the past, the region supported a variety of wildlife species including mule deer and pronghorn antelope. Other than mule deer, the Project Area contains no designated range for big game species.

Raptors

Raptor species nest in a variety of habitats including, but not limited to habitats available in and near the Project Area such as native and non-native grasslands, agricultural lands, live and dead trees, and escarpments. Suitable nesting habitat for two raptor species is present throughout the Project Area. As of August 2014 there were no known active raptor nests within the Project Area; however, there is suitable burrowing owl and ferruginous hawk habitat in the Project Area (Ottertail 2014). See Section 3.3.4 Sensitive Species for a description of these species.

Other raptor species which may occur within the Project Area include Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), great horned owl (*Bubo virginianus*), and short-eared owl (*Asio flammeus*) (Pardieck et al. 2014). The ferruginous hawk is a BLM sensitive species and is discussed further in Section 3.3.4 Sensitive Species.

Other Wildlife Species

Many of the wildlife species with potential to occur in the Project Area are associated with short grass prairie ecosystems. Common mammal species include American badger (*Taxidea taxus*), coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), black-tailed jack rabbit (*Lepus californicus*), eastern cottontail (*Sylvilagus floridanus*), and big brown bat (*Eptesicus fuscus*). Common bird species include western meadowlark (*Sturnella neglecta*), American kestrel (*Falco sparverius*), horned lark (*Eremophila alpestris*), and killdeer

(*Charadrius vociferous*). Common reptiles include Texas horned lizard (*Phrynosoma cornutum*) and prairie rattlesnake (*Crotalus viridis*) (USFS 2014).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Big Game

Noble has committed to a consolidated design for the Proposed Action, which would reduce truck traffic and the potential for collisions with big game species. Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts to terrestrial wildlife.

The Proposed Action would result in approximately 82.5 acres and 21.9 acres of initial surface disturbance on private surface lands in CPW-designated severe winter range/winter range, and winter concentration area respectively for mule deer. This would be reduced to 45.2 acres for severe winter range/winter range and 6.1 acres with interim reclamation. The Proposed Action could have limited impacts on big game species such as mule deer and pronghorn, which move through the area intermittently.

Direct effects to big game species and their habitat include short- and long-term surface disturbance and habitat loss associated with construction, reduction or degradation of available forage, and increased potential for wildlife-vehicle collisions. Additional indirect effects could include the spread of invasive plants that reduce habitat quality and avoidance of the Project Area post-development.

Raptors

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts to raptors.

There are currently no active or inactive raptor nests within the Project Area; however, raptors may use the Project Area for foraging, and there is suitable burrowing owl and ferruginous hawk nesting habitat (See Section 3.3.4 Sensitive Species). The Proposed Action would result in the loss of approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres in potential nesting, breeding, and foraging habitat for raptors. Potential effects to raptors include direct mortality due to collisions with vehicles. Other direct impacts include the loss or degradation of foraging habitat. Indirect impacts include disturbance from human activity during construction and drilling, displacement from suitable habitats due to increased noise levels and visual disturbances on the landscape, and reduced habitat values in foraging areas due to prey displacement or invasive plant invasion.

Other Wildlife Species

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and would reduce impacts to other wildlife species.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. Surface disturbance could impact other wildlife species (See Affected Environment above for a list of species). Direct effects to other wildlife species and their habitat include short- and long-term surface disturbance and habitat loss associated with construction, reduction or degradation of available forage and prey species, and increased potential for wildlife-vehicle collisions. The proposed Action could also fragment habitat, limit dispersal, and result in avoidance or displacement due to increased human activity, noise from equipment operation, and increased vehicular traffic. Additional indirect effects could include the spread of invasive plants that reduce habitat quality.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to terrestrial wildlife could be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to terrestrial wildlife species.

3.3.4 Sensitive Species

Affected Environment

The Colorado BLM and USFS Region 2 each maintain a statewide sensitive species list, which includes species of conservation interest respectively that are monitored and managed to maintain viable populations so that federal actions do not result in an Endangered Species Act (ESA) listing of those species. Table 3-15 identifies BLM and USFS Region 2 sensitive wildlife species with the potential to occur in or immediately adjacent to the Project Area. There are no sensitive plant species known to occur in or near the Project Area.

Table 3-15. Sensitive Species with Potential Occurrence in the Project Area

Species	Habitat Association	Potential Occurrence[1]	BLM[2]	USFS[3]
Mammals				
Black-tailed prairie dog *Cynomys ludovicianus*	Grasslands, prairie	Documented	Y	Y, MIS
Swift fox *Vulpes velox*	Short-grass prairie	High	Y	Y
Birds				
Burrowing owl *Athene cunicularia*	Grasslands in or near prairie dog towns	High	Y	Y, MIS
Ferruginous hawk *Buteo regalis*	Semiarid open country, primarily grasslands	High	Y	Y, MIS
Mountain plover *Charadrius montanus*	Short-grass plains; observed in Pawnee National Grassland	High	Y	Y, MIS

Sources: USFS 2013, BLM 2009, USFS 1997

[1]Potential Occurrence; Documented = this species has been observed within the Project Area during onsite visits or by recent biological surveys. High = This species has identified suitable habitat in the Project Area based on recent biological surveys.
[2]Y = Yes, this is a BLM sensitive species as reported for the Royal Gorge Field Office.
N = No, this is not a BLM sensitive species as reported for the Royal Gorge Field Office.
[3]Y = Yes, this is a USFS sensitive species as reported for Region 2. MIS = Management Indicator Species

General and sensitive species wildlife surveys were conducted by contractors for Noble in the Project Area in 2013 and 2014. Black-tailed prairie dog has been documented within the Project Area during onsite visits and during recent surveys.

Black-tailed Prairie Dog

Black-tailed prairie dog overall range overlaps the entire Project Area and active burrows were observed during onsite visits to the Project Area and during surveys conducted by Noble in May and June, 2013, and in spring, 2014 (Ottertail 2014, Walsh 2013a, Walsh 2013b). These biological surveys observed a prairie dog colony in Township 9N, Range 59W, Section 10 (SW corner), Section 11 (SE corner), Section 15 (NE corner) which is approximately 7.5 acres (Walsh 2013a), and another small colony of unknown size Township 9N, Range 59W, Section 12 (Ottertail 2014). Black-tailed prairie dogs occur in scattered colonies throughout the RGFO in shortgrass prairie.

Black-tailed prairie dogs have been referred to as a highly interactive species based on their role in grazing, burrowing, and as a prey species within the grassland ecosystem (USFS 2014). The black-tailed prairie dog is considered a Colorado state species of concern; however, it is also designated as a pest species by the Colorado Department of Agriculture and can be legally controlled on private lands year-round. The USFS selected the black-tailed prairie dog as a Management Indicator Species (MIS) in the Pawnee National Grasslands for the Prairie Dog Town community.

Swift Fox

Swift fox (*Vulpes velox*) overall range overlaps the entire Project Area and there is suitable swift fox habitat in the Project Area (SWCA 2015, Ottertail 2014 Walsh 2013b). The swift fox was once designated by the USFWS as a candidate species under the Endangered Species Act (ESA); however, this status was removed in 2001 based on research that demonstrated viable populations occurred in approximately 40 percent of its historic range and evidence that swift foxes were more tolerant of modified land uses than previously believed (USFWS 2001).

Burrowing Owl

Burrowing owls are commonly found in shortgrass prairie habitat and in prairie dog colonies throughout Colorado (Colorado Partners in Flight 2000a). There is suitable nesting habitat for burrowing owl throughout the Project Area on proposed well pads and EcoNodes located in Township 9N, Range 59W, Sections 11, 15, and 22 based on the presence black-tailed prairie dog colonies. Surveys for burrowing owls were conducted by Noble in 2013 and 2014; however, no burrowing owls have been observed within the prairie dog colonies (Ottertail 2014, Walsh 2013a).

Ferruginous Hawk

Ferruginous hawks nest in isolated trees, small groves of trees, or other elevated sites such as rock outcrops, utility poles, and low cliffs adjacent to grassland or shrubsteppe areas. Ferruginous hawks are closely associated with prairie dog colonies, especially in winter (Colorado Partners in Flight 2000b). Suitable habitat for this species occurs in the Project Area. Recent biological surveys identified two inactive ferruginous hawk nests in Township 9N, Range 59W, Section 10 (Ottertail 2014). These nests were also confirmed inactive in 2013 (Walsh 2013c). Both inactive nests are approximately 0.5 mile northwest of proposed development in Section 10, which includes a well pad and EcoNode. The USFS includes the ferruginous hawk as an MIS in the Pawnee National Grasslands for shortgrass prairie and midgrass prairie.

Mountain Plover

The mountain plover inhabits shortgrass prairie composed of bare ground or sparse vegetation or agricultural fields during the breeding season. The presence of black-tailed prairie dogs can facilitate the creation of suitable nesting and foraging habitat for mountain plover because their preference to keep vegetation short to maintain a line of sight for predators may result in the creation of bare ground within prairie habitats. Suitable habitat for mountain plover occurs in the Project Area (SWCA 2015, Ottertail 2014, Walsh 2013b). Over 50 percent of the continental population of mountain plovers is believed to breed in eastern Colorado (CDOW 2009). The USFS selected the mountain plover as an MIS in the Pawnee National Grasslands for shortgrass prairie.

Environmental Effects

<u>Proposed Action (Direct and Indirect Impacts)</u>

Noble would comply with CPW's Action to Minimize Adverse Impacts to Wildlife Resources (CDOW 2008) as amended on March 16, 2012 which includes species-specific recommendations for prairie dog, ferruginous hawk, burrowing owl, mountain plover, and swift fox. The adoption of these BMPs would reduce the potential for any adverse impacts to these species as a result of the Proposed Action. Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts to sensitive species.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres, which could affect breeding and foraging habitat loss for swift fox, burrowing owl, ferruginous hawk and mountain plover. The Project Area has been previously developed for agricultural purposes as well as oil and gas resources. The private lands on which the well pads, EcoNodes, and associated infrastructure and facilities are proposed are supported by various existing infrastructures including roads, pipelines, and water wells. Direct impacts could also include mortality to individuals from construction activities and increased vehicular traffic in and near suitable habitat.

Although proposed development falls within a 0.5-mile of the inactive ferruginous hawk nests in Section 10, these nests have been confirmed inactive for the past two years (Ottertail 2014).

Indirect impacts to swift fox, burrowing owl, ferruginous hawk and mountain plover could result from the increase in human activity during the drilling phase, causing an increase in stress to individuals, or limiting their movement throughout the Project Area. Additional indirect impacts would include habitat fragmentation, displacement of individuals, and habitat degradation by dispersal of invasive plant species. The Proposed Action would affect potential prairie dog habitat based on recent surveys of prairie dog colonies in the Project Area. Due to the scattered distribution of black-tailed prairie dogs, avoidance of all occupied burrows is often impractical. Additional indirect effects to prairie dogs include weed invasions which may lead to a decrease in the amount of native perennials and bare ground, thereby degrading habitat for prairie dogs by decreasing visibility, forage quality, and suitability for colony establishment. Development could also result changes or losses in vegetation structure that make habitat suitable for nesting, and reduction of prey species (e.g., prairie dogs, rabbits, mice, and insects); however, it is anticipated that this would have a nominal effect on these species due to other available habitat in the area.

If construction occurs during the winter months, construction or drilling activities could result in short term, temporary displacement for ferruginous hawks that forage in prairie dog colonies.

Project-related surface disturbance would result in the reduction of potential burrowing owl nesting habitat and could reduce the potential for burrowing owls to use suitable habitat, and could further affect burrowing owl nests if they become active. CPW recommends restrictions on surface disturbance within 300-feet of active burrowing owl burrows. Noble would comply with this recommendation and would not conduct surface disturbance within 300-feet of active burrowing owl nest sites between March 1 and August 15.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to sensitive species could be similar to impacts described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to sensitive species.

3.3.5 Migratory Birds

Affected Environment

The MBTA includes guidance for the protection of native passerines (songbirds) as well as birds of prey, migratory waterbirds (waterfowl, wading birds, and shorebirds), and other species such as doves, hummingbirds, swifts, and woodpeckers. Within the context of the MBTA, “migratory” birds include non-migratory "resident" species as well as true migrants, essentially encompassing most native bird species. The nesting time period is of special importance as the ability to create a nest, incubate, and rear chicks to fledging is a vulnerable time period for birds, and disturbances to nesting activities can lead to larger consequences for individual birds. In addition, because birds are generally territorial during the nesting season, their ability to access and utilize sufficient food is limited by the quality and availability of the territory occupied. During non-breeding seasons, birds are generally non-territorial and able to feed across a larger area and wider range of habitats.

Table 3-16. Migratory Bird Species of the Central Shortgrass Prairie Observed in the Project Area

Common Name	Scientific Name	BCC[1]	CO PIF or BLM Priority Species[2]	BLM Sensitive[3]	USFS Sensitive[4]	Year of Most Recent BBS Identification (number of individuals)[3]	
						Briggsdale	***Stoneham***
Brewer's sparrow	*Spizella breweri*	-	-	Yes	Yes	2008 (1)	2008 (3)
Burrowing owl	*Athene cunicularia*	Yes	Yes	-	Yes	2013 (2)	2013 (2)
Cassin's sparrow	*Aimophila cassinii*	-	Yes	-	Yes	2008 (23)	2013 (5)
Chestnut-collared longspur	*Calcarius ornatus*	Yes	-	-	Yes	2008 (5)	N/A
Ferruginous hawk	*Buteo regalis*	-	Yes	Yes	Yes	2008 (2)	2012 (1)
Golden eagle	*Aquila chrysaetos*	Yes	-	-	-	1992 (1)	2002 (1)
Grasshopper sparrow	*Ammodramus savannarum*	-	Yes	-	Yes	2013 (13)	2013 (20)
Lark bunting	*Calamospiza melanocorys*	Yes	Yes	-	-	2013 (46)	2013 (131)
Loggerhead shrike	*Lanius ludovicianus*	-	-	-	Yes	2013 (1)	2013 (2)
McCown's longspur	*Calcarius mccownii*	Yes	Yes	-	Yes	2007 (8)	2013 (4)
Mountain plover	*Charadrius montanus*	Yes	Yes	Yes	Yes	2008 (3)	1994 (2)
Prairie falcon	*Falco mexicanus*	Yes	Yes	-	Yes	2006 (2)	N/A
Short-eared owl	*Asio flammeus*	-	Yes	-	Yes	2002 (1)	2012 (1)
Swainson's hawk	*Buteo swainsoni*	-	Yes	-	-	2013 (1)	2013 (4)
Upland sandpiper	*Bartramia longicauda*	Yes	Yes	-	-	N/A	2012 (1)

Source: Pardieck et al. 2014.

[1]USFWS 2008.
[2]Colorado Partners in Flight 2000c.
[3]BLM 2009
[4]USFS 2013
[5]The Briggsdale and Stoneham breeding bird survey routes are the closest survey routes to the project area. Breeding bird survey data was obtained from Pardieck et al. 2014.

BBS Breeding Bird Survey
BCC Birds of Conservation Concern
BLM Bureau of Land Management
N/A Not applicable
PIF Partners in Flight
RMBO Rocky Mountain Bird Observatory

The BLM-USFWS Memorandum of Understanding (BLM MOU WO-230-2010-04)) (2010) promotes the conservation of migratory birds, complying with EO 13186 (66 FR 3853). The Project Area is located in the shortgrass prairie ecosystem on private lands used primarily for cultivating crops and oil and gas production. There are several migratory birds that may be found in the Project Area at some time throughout the year. Table 3-16 lists the migratory bird species that may occur in the Project Area based on their habitat requirements, the U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (BCC) (2008) list for BCR-18 (shortgrass prairie), BLM Priority Migratory Birds, Colorado Partners in Flight Birds of Conservation Concern, and Breeding Bird Survey (BBS) route data (2013). These species are listed as birds of conservation concern and priority birds because their population trends are declining across their range.

No BBS routes are located in the Project Area; however, two routes located nearby are the Briggsdale (17005) route to the southwest, and the Stoneham (17206) route to the southeast. A total of 30,216 individuals representing 67 species were identified on the Briggsdale route on 39 surveys between 1968 and 2013. Nineteen surveys on the Stoneham route between 1992 and 2013 identified a total of 13,053 individuals representing 66 species. The mourning dove, horned lark, lark bunting, and western meadowlark were the four most abundant species observed on both survey routes. Table 3-16 also indicates priority species identified by the Colorado Partners in Flight in the Central Shortgrass Prairie Region (Physiographic Region 36).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Noble would refrain from conducting habitat disturbing activities (i.e., removal of vegetation, brush, or grass) between May 15 and July 15 which is the breeding and brood-rearing season for most Colorado migratory birds. This measure would reduce potential impacts to these species. Noble would also follow measures in the BLM IM 2008-050 and would implement construction designs which would reduce the potential for any take of migratory birds. Refer to Section 2.2.1.11 Design Mitigation Features of this EA for additional applicant-committed measures that are specific to development in the Project Area and could reduce impacts to migratory birds.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres some of which is potential breeding, nesting, and foraging habitat for the migratory birds identified in Table 3-8. The Project Area and surrounding areas are already disturbed by oil and gas development and associated infrastructure. Direct and indirect impacts to migratory birds would be similar to those described for raptors in Section 3.3.3 General Wildlife.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to migratory birds would be the similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to migratory birds.

3.3.6 Threatened, Endangered, and Proposed Species

Affected Environment

Endangered plants and animals are listed under the ESA of 1973 (as amended) as being in danger of extinction throughout all or a portion of its range. Threatened plants and animals are listed under the ESA as likely to become endangered within the foreseeable future throughout all or a portion of its range. A proposed species is any species of fish, wildlife, or plant that is proposed in the Federal Register to be listed under Section 4 of the ESA. There are no species proposed for federal listing identified within the Project Area.

Four species federally listed as threatened with potential to occur in the Project Area, which includes a buffer around proposed disturbance, based on a USFWS (2015) species list include: Mexican spotted owl (*Strix occidentalis lucida*), Preble's meadow jumping mouse (*Zapus hudsonius preblei*), Colorado butterfly plant (*Gaura neomexicana var. coloradensis*), and Ute ladies'-tresses orchid (*Spiranthes diluvialis*). There are no endangered, or proposed species listed for the Project Area. Critical habitat for Mexican spotted owl, Preble's meadow jumping mouse, Colorado butterfly plan and Ute ladies'-tresses orchid is not in the Project Area or in the vicinity of the Project Area (USFWS 2015).

No suitable habitat for the threatened species identified above occurs in the Project Area. The Mexican spotted owl resides in mature forests within steep canyons which are not present in the Project Area; therefore, this species has been dropped from further analysis.

There are no riparian areas within the Project Area; therefore, there is no suitable habitat for Preble's meadow jumping mouse, Colorado butterfly plant, or Ute ladies'-tresses orchid due to the lack of riparian and wetland communities in the Project Area.

The following threatened and endangered species occur in the downstream riparian habitats of the North Platte River in Nebraska and are listed by the USFWS as species that could be impacted by activities that cause water depletions. There is no suitable habitat for these species in the Project Area.

- Least tern (*Sterna antillarum*) (Endangered)
- Piping plover (*Charadrius melodus*) (Threatened)
- Whooping crane (*Grus americana*) (Endangered)
- Pallid sturgeon (*Scaphirhynchus albus*) (Endangered)
- Western prairie-fringed orchid (*Platanthera praeclara*) (Threatened)

Because the proposed action would result in the depletion of approximately 1,245 ac-ft of water from within the Platte River Basin, this project falls under BLM Colorado's Programmatic Biological Assessment (PBA) for water depleting activities associated with the BLM's fluid minerals program in the Platte River Basin in Colorado (BLM 2015a).

Consultation History for the Species Analyzed

In response to BLM's PBA, the USFWS issued a Programmatic Biological Opinion (PBO) (06E-24000-2014-F-0671) on February 2, 2015, which concurred with BLM's determination that water depletions are "Likely to Adversely Affect" the whooping crane, interior least tern, northern Great Plains population of the piping plover, pallid sturgeon, western prairie-fringed orchid (collectively referred to as the target species), and designated critical habitat of the whooping crane. However, the USFWS also determined that BLM water depletions from the Platte River Basin are not likely to jeopardize the continued existence of the whooping crane, interior least tern, northern Great Plains population of the piping plover, the pallid sturgeon, and the western prairie fringed orchid, and that BLM water depletions are not likely to destroy or adversely modify designated critical habitat for the whooping crane.

Conservation Agreements for Platte River Species

The Platte River Recovery Implementation Program (PRRIP), established in 2006, is implementing actions designed to assist in the conservation and recovery of the target species and their associated habitats along the central and lower Platte River in Nebraska through a basin-wide cooperative approach agreed to by the States of Colorado, Nebraska, and Wyoming and the U.S. Department of the Interior. The PRRIP addresses the adverse impacts of existing and certain new water related activities on the target species and associated habitats, and provides ESA compliance for effects to the target species and whooping crane critical habitat from such activities including avoidance of any prohibited take of such species. The PRRIP serves as the reasonable and prudent alternative to offset the effects of water related activities that FWS found were likely to cause jeopardy to one or more of the target species or to adversely modify critical habitat.

The PBO addresses water depletions associated with fluid minerals development on BLM lands, including water used for well drilling, hydrostatic testing of pipelines, dust abatement on roads, and seismic activity. The PBO includes reasonable and prudent alternatives developed by the USFWS which allow the BLM to authorize oil and gas wells that result in water depletion while avoiding the likelihood of jeopardy to the endangered species and avoiding destruction or adverse modification of their critical habitat. The PBO confirms ESA compliance for water-related activities of oil and gas producers that elect to rely on the PRRIP through maintaining membership in good standing in the South Platte Water Related Activities Program, Inc. (SPWRAP) organization.

The SPWRAP organization is formally charged with certifying to the USFWS that water users in Colorado are meeting the requirements to support reliance on the PRRIP for ESA compliance purposes. Among other things, SPWRAP assists the State of Colorado in complying with its financial and water requirements under the PRRIP. This includes implementation of groundwater recharge operations at times when South Platte River flows are in excess of the needs of endangered species and allowing the return of water to the river when flows are less than needed by endangered species.

Noble has provided proof of current membership in SPWRAP as of June 4, 2015 and therefore is considered to be in compliance with the ESA as to the depletive effects that may result from their activities on federally listed species and designated critical habitat associated with the Platte River in Nebraska].

As they are drilled and completed individual wells will be entered into the RGFO fluid minerals water depletion log which will be submitted to the BLM Colorado State Office at the end of the Fiscal Year.

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

The Proposed Action would have “no effect” on Mexican spotted owl, Preble’s meadow jumping mouse, Colorado butterfly plant, and Ute ladies’-tresses orchid because no suitable habitat is present within the Project Area.

Tiering to the 2015 Programmatic Biological Assessment and PBO, the Proposed Action “may affect but is not likely to adversely affect” the whooping crane, interior least tern, northern Great Plains population of the piping plover, pallid sturgeon, and western prairie-fringed orchid because Noble has committed to participate in SPWRAP and will remain in good standing.

Additionally, the Proposed Action "may adversely affect but would not likely jeopardize" the critical habitat for whooping crane because Noble has committed to participate in SPWRAP and will remain in good standing.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to threatened, endangered, and proposed species.

3.4 Heritage Resources and Human Environment

3.4.1 Cultural Resources

Affected Environment

Cultural resources include prehistoric and archaeological sites, archaeological districts, and buildings, structures, or objects created or modified by human activity. Cultural resources are finite, nonrenewable resources that cannot be returned to their original states once they have been altered, damaged, or removed. Cultural resources are protected by the National Historic Preservation Action of 1966 (NHPA) and the Archaeological Resources Protection Act of 1979 (ARPA).

The BLM RGFO conducted a review of known cultural resources within the Project Area. Several prehistoric and historic sites and isolated finds are present in the vicinity of the Project Area (Report CR-RG-15-113 P). Site 5WL7780 is a "Needs Data" site and is therefore treated as eligible for the National Register of Historic Places (NRHP).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

All surface-disturbing activities would be conducted to avoid any impacts to eligible cultural resources. In the event of inadvertent discovery of cultural resources, construction activities would be halted and proper notifications would be made, as needed. Refer to Section 2.2.1.11 Design Mitigation Features of this EA for additional applicant-committed measures that are specific to development in the Project Area and could reduce impacts to cultural resources.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. While Site 5WL7780 is eligible for the NRHP, the BLM has determined that the Proposed Action will not affect this site or any other historic properties.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to cultural resources could be similar to those described for the Proposed Action.

<u>*Mitigation Measures*</u>

No additional mitigation measures would be required to offset impacts to cultural resources.

3.4.2 Native American Religious Concerns

Affected Environment

In August 2013, BLM conducted a consultation (Project CR-RG-13-43 NA) with the following tribes, in order to determine whether any properties of concern are present in Weld County: Apache Tribe of Oklahoma, Cheyenne and Arapaho Tribes of Oklahoma, Cheyenne River Sioux Tribe, Comanche Tribe of Oklahoma, Crow Creek Sioux, Eastern Shoshone, Jicarilla Apache Nation, Kiowa Tribe of Oklahoma, Northern Arapaho Tribe, Northern Cheyenne Tribe, the Ute Tribe, Oglala Sioux Tribe, Pawnee Tribe, Rosebud Sioux Tribe, Southern Ute Tribe, Standing Rock Lakota Tribe, and the Ute Mountain Ute Tribe. No properties of traditional religious and cultural significance in Weld County were identified by the tribes. Therefore, no direct or indirect impacts to properties of concern to the tribes are anticipated.

Although aboriginal sites are present in the vicinity of the Project Area, no possible traditional cultural properties were located during the cultural resources inventory (see Cultural Resources section, above). There is no other known evidence that suggests the project area holds special significance for Native Americans.

Environmental Effects

<u>*Proposed Action (Direct and Indirect Impacts)*</u>

No Native American religious concerns were identified within the Project Area; therefore, there are no direct or indirect impacts anticipated for Native Americans or associated aboriginal or cultural sites as a result of the Proposed Action.

<u>*No Action Alternative (Direct and Indirect Impacts)*</u>

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals but would not access the federal minerals. Direct and indirect impacts to cultural resources could be similar to those described for the Proposed Action.

<u>*Mitigation Measures*</u>

No additional mitigation measures would be required to offset impacts to Native American religious concerns.

3.4.3 Paleontological Resource

Affected Environment

Paleontological resources on federal lands are protected under provisions of the FLPMA, as amended, 43 U.S.C. 1737(b), PL 94-579; PL111-011, Omnibus Public Land Management Act of 2009, Subsection D, Section 6302; and 43 CFR 3802 and 3809. The Project Area is geographically located in rangeland overlying part of the geologic feature that is the eastern flank of the DJ Basin Province. The DJ Basin

Province, also known as the Julesburg Basin, is an asymmetrical Laramide-age structural basin located in eastern Colorado, southeastern Wyoming, the southwestern corner of South Dakota, and the Nebraska Panhandle (Higley et al. 1995). Two basin deeps are located along the axis of the DJ Basin near the Front Range of Colorado separated by the steeply dipping western flank and gently dipping eastern flank (Higley et al. 1995).

Geologic units occurring at or near the surface can be used to predict the relative abundance of scientifically significant paleontological resources contained within them. The BLM uses a Potential Fossil Yield Classification (PFYC) system of geological units with respect to their potential for the production of scientifically important fossils, which ranges from PFYC 1 (lowest fossil potential) to PFYC 5 (highest fossil potential). According to the BLM's PFYC system, the Project Area is underlain by 7,975 acres of PFYC 5 and 11 acres of PFYC 3 geologic units. PFYC 3 geologic units are moderately fossiliferous, while PFYC 5 units are highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils. Therefore, the potential for the proposed project to be sited on or impact a scientifically significant fossil locality is high.

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Paleontological resources are considered to be part of the surface estate. The BLM recommends that a field inventory be performed prior to any surface-disturbing activity; however, the surface owner may elect to waive these recommendations. Such a waiver must be documented in the casefile.

If any significant fossils are found throughout the proposed project, development of a research design and data recovery may also be recommended before the project proceeds. Any fossils recovered on private land belong to the private landowner; however, the BLM recommends the use of a federally approved repository for storage of any fossils recovered in these efforts.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. All proposed project activities would occur on the White River Formation, which has a PFYC 5 (very high). Based on the project location within a PFYC 5 area, fossil locations and occurrences may be encountered during construction of the Proposed Action. Therefore, proposed project activities may result in direct impacts to existing and undiscovered paleontological resources.

Potential impacts to fossil localities could be both direct and indirect. Direct impacts to or destruction of fossils would occur from unmitigated activities conducted on formations with high potential for important scientific fossil resources. Indirect impacts would involve damage or loss of fossil resources due to the unauthorized collection of scientifically important fossils by workers or the public due to increased access to fossil localities in the Project Area. Adverse impacts to paleontological resources can be reduced to a negligible level through mitigation of ground-disturbing activities, as described further below. It should be noted that beneficial impacts to paleontological resources could result if surface-disturbing activities associated with the Proposed Action result in the discovery of scientifically important fossil resources.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to paleontological resources would be the similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to paleontological resources.

3.4.4 Socioeconomic Resources

Affected Environment

The Proposed Action is located entirely within Weld County. In 2013, Weld County's population was 269,785 representing a 6.7 percent increase from 2010, compared to statewide Colorado population growth of 4.8 percent during the same period. Weld County is comprised of a 67.2 White population, 28.4 percent Hispanic or Latino population, 1.3 percent African American population, 1.7 percent Native American population, and 1.4 percent Asian population (USCB 2014b).

Weld County's economy is based on agriculture, construction, and natural resource production. In 2013, Weld County's labor force totaled 127,151 people and its unemployment rate was 7.1 percent which is higher than Colorado's May 2013 unemployment rate of 6.9 percent (USBLS 2014a, USBLS 2014b). Median household income between 2008 and 2012 was $56,589 and 14.4 percent of the population in Weld County lived below the poverty level between 2008 and 2012 (USCB 2014b).

In the past ten years, oil and gas development has increased steadily in Weld County. In 2004, oil production for all of Weld County was 11,107,840 barrels with sales of 10,987,517 barrels. In 2014 oil production was 12,294,426 with sales of 12,267,389 barrels, an increase in the past ten years of 1,186,586 barrels of oil produced and 1,279,872 barrels of oil sold (COGIS 2014).

The federal government makes payments in lieu of taxes (PILT) to County governments to help offset property tax revenue lost on nontaxable federal lands within County boundaries (BLM 2006). The PILT distributions are based on acres for all federal land management agencies (e.g., approximately 197,320 acres in Weld County). By formula, payments are decreased as other federal funds, such as mineral royalty payments, increase. Table 3-17 shows the PILT received by Weld County in the last five years.

Table 3-17. Federal Payments in Lieu of Taxes to Weld County

Year	PILT Amounts
2014	$70,924
2013	$341,191
2012	$67,022
2011	$65,048
2010	$65,053

Source: USDI 2014

In addition to PILT payments, the BLM shares revenue generated by commercial activities on public lands with state and county governments (BLM 2006). Federal mineral royalties are collected on oil and gas production from federal mineral leases. Half of the royalty receipts are distributed to Colorado; the $2,082,377 received by Weld County in 2013 was allocated to fund county services, schools, and local communities (DOLA 2013).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

The Proposed Action would positively impact socioeconomic resources in Weld County and in nearby communities which would complement Noble legacy development and additional ongoing oil and gas development. Direct impacts from the Proposed Action would include payments received from the leasing of federal mineral estate and an increase in employment. Indirect impacts could include increased employment opportunities in industries related to oil and gas and economic benefit to federal, state, and county governments related to lease payments, royalty payments, severance taxes, and property taxes.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. There would be no direct impacts to socioeconomic resources because there would be no payments received from leasing of federal mineral estate; however, indirect impacts from the exploration and development of private land and private minerals would be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to socioeconomic resources.

3.4.5 Visual Resources

Introduction

BLM and USFS manage landscapes and scenic values for varying levels of protection and modification, giving consideration to other resource values and uses and the scenic quality of the landscape. Visual resources (the landscape) consist of landform (topography and soils), vegetation, bodies of water (lakes, streams, and rivers), and human-made structures (roads, buildings, and modifications of the land, vegetation, and water). These elements of the landscape can be described in terms of their form, line, color, and texture or pattern. Normally, the wider variety of these elements in a landscape, the more interesting or scenic the landscape becomes, if the elements exist in harmony with each other.

Bureau of Land Management

The BLM developed the Visual Resource Management (VRM) system to identify and protect scenic values on public lands. The VRM system provides the methodology to inventory existing scenic quality. The Visual Resource Inventory (VRI) process provides the BLM with a means to determine visual values based on scenic quality, viewer sensitivity, and a delineation of distance zones (BLM 1986b). The RGFO does not have a current VRI; it is in development and only preliminary data is available. The information in Table 3-18 represents best available data; it is not final data and may be adjusted by the BLM.

The BLM has established four VRM Classes to serve as both an inventory tool portraying the relative value of existing visual resources and a management tool portraying visual management objectives for the respective classified lands. Management objectives for each of the VRM Classes are described as follows (REF 4071).

- **VRM Class I.** The objective is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and should not attract attention.
- **VRM Class II.** The objective is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- **VRM Class III.** This objective is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- **VRM Class IV.** The objective is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and may be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements of the landscape.

United States Forest Service

USFS Manual 2300, *Recreation, Recreation, Wilderness, and Related Resource Management*, Chapter 2380 – Landscape Management, requires the inventory, evaluation, management, and, where necessary, restoration of scenery as a fully integrated part of the ecosystems of NFS lands and of the land and resource management and planning process. This manual specifies a requirement to "Ionduct and document a scenery assessment for all activities that may affect scenic resources and that require analysis under NEPA. Ensure application of the principles of landscape aesthetics, scenery management, and environmental design in project-level planning (p. 2380.43.4-5)." Individual forest land and resource management plans identify the scenic integrity objectives (SIOs) specified for each management area. Scenic integrity indicates the degree of intactness of the landscape character or, conversely, the degree of visible disruption of the landscape character. A landscape with very minimal visual disruption is considered to have high scenic integrity (REF 4070). The ARNF and PNG LRMP (USFS 1997) establishes SIOs in the Project Area. These SIOs include:

- Low: Landscapes where the valued landscape character "appears moderately altered." Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetation type changes, or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.

- Moderate: Landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed.
- High: Landscapes where the valued landscape character "appears intact." Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.

Affected Environment

Visual Resources and Scenery Management

Although the BLM establishes VRM Classes regardless of surface ownership, VRM Class objectives and management only apply to BLM-administered land. There are no BLM-administered lands within the Project Area. Table 3-18 shows the VRM classes assigned to the private and NFS lands within the Project Area.

Table 3-18. Visual Resources Management Classes in the Project Area

VRM Class	Acres in Project Area
Class II	1,648
Class III	4,336
Class IV	297

Source: BLM 2015b (preliminary GIS data).

The Project Area contains 1,597 acres of NFS lands; the entire area has a Moderate SIO (USFS 2015). The Pawnee Buttes Special Interest Area (SIA) is approximately 4.5 miles from the Project Area. The SIO for the Pawnee Buttes SIA is High, but distance and intervening topography render this project not visible from the Buttes.

Characteristic Landscape

The Project Area is generally located in a remote area where the landscape has evolved from open prairies into a more rural pastoral setting with increasing oil and gas development. As of February 2015, there were 35 wells associated with oil and gas development within a one-mile radius of the proposed well pad locations. These wells were in various stages of production, reclamation, and abandonment (COGCC 2015a). In addition to these existing oil and gas wells, there are 13 active permitted locations, 12 of which were submitted by Noble. Water supply wells and storage ponds also exist in the Project Area.

The landscape in the Project Area has been moderately altered by the existing road network to support ranches and existing oil and gas operations. These elements contribute to visual degradation of the valued landscape character and sense of place. The lack of vegetation and the presence of imported aggregate on the surface introduce colors, lines, forms and textures that are in contrast with the surrounding areas and the PNG.

The lines, forms, and colors in the Project Area are mostly consistent with the natural scenery of the landscape but are contrasted with existing oil and gas development. Other existing activity affecting the characteristic landscape in the Project Area includes a few residences, sparsely distributed range improvements, and unimproved roads associated with livestock grazing and range management.

Viewpoints of the Project Area

Due to the remote location of and limited access to the Project Area, the primary locations with views of the Project Area include travel routes and two residential homes. Several county roads traverse or skirt the Project Area. The nearest residence to the Project Area is approximately 0.5 mile from the proposed development. The portion of the PNG encompassed by the Project Area is designated in the 1997 Forest Plan as Management Area 6.6 – Mid Composition Low Structure: Grassland Resource Production, where a wide variety of improvements may be present, including oil wells and oil and gas production facilities. This area has limited public access and use; there are no other sensitive viewing locations in the Project Area.

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts to visual resources.

The Proposed Action would result in approximately 305 acres of initial surface disturbance on private surface land, which would be reclaimed to a total long-term disturbance of approximately 141 acres. The short-term direct effects to visual resources would be related to ground disturbance, construction activities, and associated vehicular traffic. Indirect effects would be from associated fugitive dust.

The longer-term effects of the Proposed Action on the visual resources in the Project Area would be generally related to the presence of oil and gas development equipment. This equipment would be removed and disturbed areas would be re-contoured and reseeded after the final wells are plugged. There is evidence of existing oil and gas development in the Project Area including drill rigs, storage tanks, pump jacks, and roads. The Proposed Action would increase the amount of oil and gas equipment on the landscape; however, Noble's consolidated design, with multi-well pads and EcoNodes serving multiple well pads would reduce the total amount of equipment required to support this development and would consolidate vehicular traffic, minimizing the impacts to visual resources. The consolidated project design and buried oil and gas pipelines would also serve to minimize traffic during production. Associated long-term traffic would include water trucks and vehicles associated with routine maintenance.

Indirect impacts to visual resources would result from fugitive dust during construction, which would be short-term in nature. Noble has indicated that approximately 2 ac-ft of water would be used for dust abatement during the construction phase of the development, which would minimize impacts to visual resources from fugitive dust. During the production phase of the development, associated truck traffic on dirt/gravel roads has the potential to continue to affect the visual resource; however, Noble has committed to upgrading Weld County roads within the project area with hardened, dust-resistant surfacing to reduce dust emissions where practical.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action Alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to visual resources would be the similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to visual resources.

3.4.6 Noise

Affected Environment

Noise is defined as loud, unexpected, or annoying sound. In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determine the sound level and characteristics of the noise perceived by the receiver. Sound levels have been calculated for areas that exhibit typical land uses and population densities. The Project Area is located in a rural agricultural area in which ambient sound levels are expected to be between approximately 30 and 40 decibels (dBA) (EPA 1974). These typical noise levels result primarily from equipment operations during ranching and farming activities and vehicular traffic on rural roads.

Oil and gas development has increased in Weld County in recent years. Oil production has increased from 5,501,022 barrels (bbl) in 1999 to 225,123,851 bbl in 2014; a 3,992 percent increase. Natural gas production has increase 115 percent since 1999; from 104,828,727 thousand cubic feet (mcf) to 225,123,851 mcf in 2014 (Drilling Edge 2015b). COGCC noise regulations for oil and gas operations at well sites, production or gas facilities in residential, agricultural, or rural zones allow 55 dBA from 7:00 am to 7:00 pm, and 50 dBA from 7:00 pm to 7:00 am (COGCC 2014).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Equipment such as trucks, construction equipment, drill rigs, and pump and generator engines would create the primary sources of noise during the drilling and development phase. The movement of heavy vehicles and drilling equipment to, from, and through the Project Area could result in frequent-to-continuous noise. Noise levels from blasting, drilling, and other activities could exceed Weld County's maximum permissible noise levels for non-specified areas, which are 55 dBA between 7:00 am and 9:00 pm, and 50 dBA between 9:00 pm and 7:00 am (Weld County 2014). There are two residences less than two miles from the Project Area. The distance from the Magpul federal well pad in Township 9N, Range 59W, Section 22 is approximately 2,500 feet northwest from the Castor Ranch House, and the Winchester federal well pad in Township 9N, Range 59W, Section 24 and is approximately 7,000 feet northeast from the Timbro Ranch House. Sound is reduced over distance, and impacts from noise to surrounding residents would be expected to be minimal.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to noise would be the same as those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to noise.

3.4.7 Wastes, Hazardous or Solid

Affected Environment

The BLM assumes that conditions associated with the surface and subsurface of the Project Area are currently clean and there is no known contamination. The application would make a determination prior to initiating the project if there is evidence that solid or hazardous wastes have been previously used, stored, or disposed of in the Project Area.

Noble would transport excess water byproducts that are not recycled via buried pipeline to an EcoNode. Noble would temporarily store this water in tanks and then transfer it to 150 barrel trucks which would take the water off-site to a professional disposal service at a permitted UIC well managed by a third party. In addition, all exploration and production wastes would be transported off the Project Area to a permitted disposal site. There would be no treatment or disposal of hazardous wastes on public lands.

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Refer to Section 2.2.1.11 Design Mitigation Features of this EA for applicant-committed measures that are specific to development in the Project Area and could reduce impacts to wastes, hazardous or solid.

Contamination of soil or groundwater could occur as a result of an accidental spill or release of hazardous materials during the construction and production phases. Spills or releases could result in contamination to soil and/or groundwater and exposure of maintenance workers and the public to hazardous materials. Runoff of contaminants into surface water could impact surface water quality. All hazardous substances brought to and stored on location would have a Material Safety Data Sheet (MSDS) and would be properly handled so as to not cause harm to the environment or people. The MSDS would be kept on location until the hazardous material is properly disposed of in accordance with federal law. All undesirable events (fires, accidents, blowouts, spills, discharges) would be reported to the RGFO.

Possible contaminant sources associated with the drilling operations are:

- Storage, use and transfer of petroleum, oil and lubricants
- Produced fluids
- General hazardous substances, chemicals and/or wastes
- Concrete washout water
- Drilling water, mud and cuttings

No Action Alternative (Direct and Indirect Impacts)

Under the No Action alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts from hazardous or solid wastes would be similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to wastes, hazardous or solid.

3.4.8 Transportation and Access

Affected Environment

Road types, or functional classifications, describe functions that roads serve in facilitating traffic flows within a transportation network. Arterial roads, such as interstates and state highways, connect population centers, accommodate high traffic volumes, and have limited access. Collector roads include state, county, and municipal roads that provide access through towns or large blocks of land, and are generally two lanes wide. Local and resource roads include county, municipal, and private roads that link areas with low traffic volumes to higher classification roads. Local roads connect to collector roads, serve a smaller area than collector roads, and may be one or two lanes with lower traffic volumes.

Primary access to the Project Area is via Interstate 76 to Colorado State Highway (SH) 52, north to SH 14. From there, Weld County Road (WCR) 390 traverses northwest toward the Project Area. WCR 104 is the main east-west road through the Project Area, and WCR 119 heads north in the eastern portion of the Project Area. The Proposed Action would use the existing road network to the maximum extent practicable.

Access routes in the Project Area include existing oil and gas roads and privately owned roads that connect to local or connector roads and are typically single lanes to individual well pads, oil and gas facilities, or residences. Table 3-19 includes primary access routes to and within the Project Area.

Table 3-19. Primary Access Routes for East Pony Oil and Gas Development Project

Road Name	Road Type	Surface Type	Maintenance Responsible Party
Interstate-76	Arterial	Pavement	CDOT
State Highway 52	Arterial	Pavement	CDOT
State Highway 14	Arterial	Pavement	CDOT
Weld County Road 390	Collector	Gravel/Dirt	Noble/Weld County
Weld County Road 119	Local	Gravel/Dirt	Noble/Weld County
Weld County Road 104	Local	Gravel/Dirt	Noble/Weld County
Existing Oil and Gas Roads	Resource	Gravel/Dirt	Oil and Gas Operators
Private Roads	Resource	Gravel/Dirt	Noble/Private Landowner

Source: Noble 2014

CDOT Colorado Department of Transportation

CDOT's 2013 annual average daily traffic (AADT) estimates for SH 14 peaks at 17,000 vehicles near its junction with SH 392, and peaks at 19,000 vehicles at its junction with WCR 390 (CDOT 2013).

Environmental Effects

Proposed Action (Direct and Indirect Impacts)

Noble would utilize existing and newly constructed pipelines to reduce traffic required for the production phase of the proposed project and would further implement a Transportation Plan to guide the management of transportation throughout the implementation of the proposed project. Refer to

Section 2.2.1.11 Design Mitigation Features of this EA for additional applicant-committed measures that are specific to development in the Project Area and could reduce impacts to transportation and access.

Direct impacts from the Proposed Action would include increases in vehicular traffic and the risk of traffic accidents on existing roadways in the Project Area from daily travel of project-related employees and operations. Indirect impacts from the additional traffic would include an increase in the rate of degradation of the existing roadways in the Project Area, fugitive dust, noise, increased potential access to remote areas, and an increased risk of vehicle collisions with livestock and wildlife.

The proposed wells and associated access roads have been identified (see Chapter 2); therefore, traffic increases can be quantified. The average one-way commute on arterial and collector roads for construction traffic would be approximately 55 miles with an additional 11.6 miles on local and resource roads; approximately 17.5 percent of the roads are not paved (Higgins 2014). Table 3-20 identifies the estimated traffic associated with construction of project infrastructure as well as drilling and completion of the proposed wells, which would occur over a duration of approximately two years.

Table 3-20. Estimated Traffic Associated with Construction, Drilling, and Completions

Phase	Average Truck Trips/Well Pad/Day		Average Truck Trips/Well/Day		Duration of Phase	Total Truck Trips/Well	
	Light Trucks	*Heavy Trucks*	*Light Trucks*	*Heavy Trucks*		*Light Trucks*	*Heavy Trucks*
Road and Pad Construction	2	4	N/A	N/A	8 days	16	32
Well Drilling	N/A	N/A	14	7	10 days	140	70
Well Completion	N/A	N/A	15	13	7 days	105	91
TOTALS						**261**	**193**

Source: Noble 2014

N/A Not applicable

Noble has also estimated the long-term traffic increases for the production phase of the Project. Traffic volumes would be highest during the first two years of production and then decrease substantially. Table 3-21 identifies the long-term associated traffic per well during the production only phase, estimated for 30 years, which is the anticipated lifetime of the proposed wells.

Table 3-21. Estimated Traffic Associated with Production (per well)

Production Phase	Duration of Phase (years)	Total Truck Trips/Well/Year	
		Light Trucks	*Heavy Trucks*
Initial	2	365	365
Long-term[1]	30	365	37
TOTALS		**730**	**402**

Source: Noble 2014

[1]Long-term is defined as the production phase of the project.

No Action Alternative (Direct and Indirect Impacts)

Under the No Action alternative, the applicant could explore and develop the private land and private minerals and not access the federal minerals. Direct and indirect impacts to transportation and access would be the similar to those described for the Proposed Action.

Mitigation Measures

No additional mitigation measures would be required to offset impacts to transportation and access.

3.5 Cumulative Impacts

Cumulative impacts are those impacts that result from the incremental impact of a proposed project when added to other past, present, and reasonably foreseeable actions, regardless of which agency or person undertakes such actions. Unless otherwise stated, the cumulative impact analysis area for each resource is the Project Area. Where the analysis area is broader, the rationale for the selection of each analysis area is included.

The proposed project is located in Weld County, Colorado, which has approximately 25,000 active petroleum wells (COGCC 2015a). The majority of these wells are located on privately owned surface and produce entirely privately owned minerals. The BLM is involved in less than five percent of all petroleum wells in Weld County (BLM 2012a). The cumulative impact of federal petroleum development, therefore, has relatively minor significance in comparison to the impact of the overall petroleum development in Weld County due to the comparatively small number of federally owned mineral parcels in the area.

Past, present, and reasonably foreseeable development in Weld County includes oil and gas development, livestock grazing, gilsonite mining, tar sands, and sand and gravel projects. Approximately 300 acres of permanent surface disturbance within the Project Area can be attributed to past activities such as road construction and oil and gas development.

The following development projects are an example of those that are to be heard by the Weld County Planning Commission (2015).

- Weld County Road 49 Corridor Project
- Agricultural development
- Telecommunications tower
- Commercial recycling facility
- Residential development

According to COGCC data (accessed June 2015) there are approximately 2,704 oil and gas drilling permits that are pending, and 14,123 oil and gas drilling permits which have been approved in Weld County. Table 3-22 indicates horizontal drilling proposals that represent reasonable foreseeable future actions as they have either been approved recently or are under consideration by the BLM RGFO within Weld County. None of these proposed projects is within the East Pony Project Area.

Table 3-22. Federal Horizontal Drilling Proposals Approved or Under Consideration in Weld County

NEPA Document ID	Description	Proponent
DOI-BLM-CO-F02-2014-006 EA	Noble DP 2 APDs (2) T2N, R66W, Sec. 5	Noble Energy
DOI-BLM-CO-F02-2014-010 EA	Razor 12-F_G_H APDs T10N, R58W, Sec. 12	Whiting Oil and Gas
DOI-BLM-CO-F02-2014-016 EA	Grant Salisbury and File APD T2N, R68W, Sec. 14, 32	Encana
DOI-BLM-CO-F02-2014-035 EA (Draft)	North Platte Federal 22 APD T5N, R63W, Sec. 22	Bonanza Creek
DOI-BLM-CO-F02-2014-038 EA	Horsetail 10 and 13 APDs T10N, R57W, Sec. 10, 13	Whiting Oil and Gas
DOI-BLM-CO-F02-2014-053 CX	Razor Federal 30K APDs T8S, R79W, Sec. 16	Whiting Oil and Gas
DOI-BLM-CO-F02-2014-0074 EA	Whiting Razor 29L, 30J, 30L, 30O APD T10N, R58W, Sec. 29, 30, 32	Whiting Oil and Gas
DOI-BLM-CO-F020-2015-0022 EA	Carrizo Sonic Star 1-12-8-60 APD T8N, R60W, Sec. 11	Carrizo Oil and Gas
DOI-BLM-CO-F020-2015-0023 EA	PDC Weidman Trust, Weidman F, Hunt and Tarin APDs T4N, R66W, Sec. 28, 29, 32	PDC

Source: BLM 2015c (BLM NEPA register on RGFO website)

3.5.1 Air Quality and Greenhouse Gases

The project region currently contains various emission sources including agricultural fields, traffic, houses, and oil and gas production. The addition of the infrastructure needed to construct, drill, and operate the additional pads, wells, and EcoNodes associated with the Proposed Action would have a cumulative impact to the area's air quality; however, the proposed wells' impact contribution to the cumulative effect would be minor, as demonstrated by the near-field modeling assessment results discussed above and in Appendix C-2. Over the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the region. This could result in a larger cumulative impact to air quality in the future. Any development that would occur within the ozone nonattainment area must comply with the additional emission control measures required by CDPHE for oil and gas activities in nonattainment areas.

Due to the spatial extent of oil and gas development, a regional-scale modeling analysis usually is warranted to determine the impacts associated with expansive cumulative increases in oil and gas development and operations. The BLM Colorado State Office recently completed the first iteration of a Colorado-wide cumulative oil and gas modeling study (the Colorado Air Resources Management Modeling Study or CARMMS) that includes analyses for each BLM Field Office, including the RGFO. For this study, oil and gas emissions increases were projected and modeled for 2021, according to projected reasonably foreseeable development in the region, as well as recent oil and gas development growth data. These projections were determined for each BLM Field Office in Colorado. Low, medium, and high development scenarios were modeled. Regional ozone and other pollutants and air quality related values (AQRVs) including visibility impacts were evaluated in CARMMS.

The CARMMS modeled AQRV impacts for the 2021 high development scenario, for the Rocky Mountain National Park Class I area, show an improvement (reduction) of 0.04 dv in the best 20% Days visibility metric, an improvement of 0.89 dv in the Worst 20% days visibility metric, and an improvement of 1.08 (kg/ha-yr) in the maximum modeled annual nitrogen deposition.

The CARMMS modeling projected year 2021 8-hour ozone design value concentrations (a metric for assessing compliance with the ozone NAAQS) at regional ozone monitoring sites. The eight monitoring sites in the CARMMS modeling domain that have current design values above the ozone NAAQS would be reduced to two sites with the 2021 high development scenario.

$PM_{2.5}$ concentrations with the 2021 high development scenario were predicted to increase in major Colorado Front Range cities and near mining operations in Colorado. With the exception of $PM_{2.5}$ concentrations near large cities, future mining operations and non-Federal oil and gas operations, the CARMMS modeling results with the high development scenario show an overall improvement in air quality in the region from the base year 2008 to year 2021.

Appendix C-3 provides further information on the CARMMS modeling results.

As future oil and gas development occurs in the RGFO region, the BLM Colorado State Office plans to compare project-specific permitted levels of emissions to the RGFO oil and gas emissions rates modeled in CARMMS, along with the corresponding modeling results, to ensure that activities for which the BLM Colorado State Office grants permits would cumulatively remain within the acceptable emissions levels analyzed in CARMMS.

With respect to GHG emissions, the EPA identified a number of climate change predictions for the Mountain West and Great Plains region including but not limited to warmer temperatures, less snowfall, earlier snowmelt, and more frequent droughts (based on BLM 2012b). If these predictions are realized, as mounting evidence suggests is already occurring, there could be impacts to natural resources within the region. The construction, operation, and maintenance of the three proposed wells would have a cumulative impact to GHG emissions; however, the proposed wells' impact would be minor. The BLM requirements listed in Section 3.2.1 (under Protective/Mitigation Measures) would help minimize the project's GHG emissions and potential climate change impact.

3.5.2 Geologic and Mineral Resources

The cumulative impact analysis area for geology is the Project Area because the geographic scope of cumulative impacts on geology would be limited to direct surface disturbance resulting from the project. Cumulative impacts on geology would result from direct surface disturbance that alters existing topography or increases geologic hazard potential. Activities most likely to result in cumulative impacts on geology include alterations to existing topography from cut-and-fill activities used to construct well pads, access roads, and other facilities and the construction of road and pipeline channel crossings. In addition, natural weathering of disturbed areas, slope and drainage alterations, and vegetation removal could result in indirect impacts on geology by altering surface drainage patterns, decreasing infiltration rates, and increasing overland flow rates.

The cumulative impact analysis area for mineral resources is the DJ Basin. Cumulative impacts on mineral resources would result from the development of proposed wells when combined with the impacts generated by past, present, and reasonably foreseeable actions in the cumulative impact analysis area. These cumulative impacts would remove mineral resources in the short term and some impacts may be irretrievable. However, the discovery and development of new mineral resources may be increased and support ongoing and reasonably foreseeable actions in the analysis area.

The cumulative impact analysis area for salable mineral resources is Weld County. The construction of roads, well pads, and other ancillary facilities associated with ongoing and future oil and gas development would increase the demand for salable minerals (e.g., sand and gravel) in or near the Project Area.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area. This would result in additional production of oil and natural gas resources, which could have a larger impact on geologic and mineral resources in the future.

3.5.3 Prime and Unique Farmlands

The cumulative impact analysis area for prime and unique farmlands (including farmland of statewide importance) is the Project Area. As discussed in Section 3.2.3 Prime and Unique Farmlands, direct, adverse impacts to prime farmland are not anticipated under the Proposed Action. As a result, the Proposed Action would not cumulatively affect prime and unique farmland. However, cumulative impacts to farmland of statewide importance would result from the initial surface disturbance of approximately 226.6 acres on farmland of statewide importance which would incrementally increase disturbances from past, present, and reasonably foreseeable activities on farmland of statewide importance within the cumulative impact analysis area. Grading, leveling, and removal of vegetation and soil from the Proposed Action in conjunction with cumulative projects would reduce soil productivity, and accelerate erosion for the lifetime of oil and gas production until final reclamation is deemed successful. Following interim reclamation, long-term disturbance from the Proposed Action would contribute to 104.2 acres of permanent disturbance on farmland of statewide importance in the analysis area.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances that could have a larger impact on farmland of statewide importance in the future.

3.5.4 Soils Resources

The cumulative impacts analysis area for soil resources is the Project Area. Any surface-disturbing activity that removes native vegetation and topsoil may cumulatively and incrementally affect soil resources by increasing erosion and sediment yield, thereby reducing soil productivity and stability. Past, present, and reasonably foreseeable actions that could result in increased erosion and sediment yield include oil and gas development, livestock grazing, and road construction. Of these actions, impacts related to road construction are the highest concern. Because active roadways would not be reclaimed for the long term, it is assumed sediment yield from existing roads and proposed road construction, including those roads used for oil and gas development, would continue at rates two to three times above background rates into the indefinite future, as compared to other authorized actions.

Soil compaction due to construction activities at well pads, along access roads, and in other disturbed areas would result in a small increase in surface runoff from the area. This increased runoff could in turn cause increased erosion. The construction and operation of each well would also incrementally increase the chance of leaks or spills, which could increase the loss of soil productivity within the area.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances that could have a larger impact on soils in the future.

3.5.5 Water Resources (Surface and Groundwater)

The cumulative impact analysis area for surface water (including floodplains) is defined as the Pawnee Watershed (HUC 10190014), which encompasses the full extent of the watershed where surface disturbance, erosion, and sedimentation could affect surface water features. Any surface-disturbing activity that would remove native vegetation and topsoil from the watershed may cumulatively and incrementally affect water resources by increasing erosion and sediment yield to area drainages and surface water features. Past, present, and reasonably foreseeable actions that could result in increased erosion and sediment yield include oil and gas development, livestock grazing, and road construction. Of these actions, surface-disturbing activities such as construction of oil and gas facilities and associated infrastructure would likely have the greatest potential impact on water resources due to increased erosion and sedimentation rates and an increased potential for leaks and spills.

The cumulative impacts analysis area for groundwater is the geographic extent of the Laramie-Fox and Upper Pierre Formations that would be used as source water for the Proposed Action. The Proposed Action would result in total groundwater depletions of an estimated 1,245 ac-ft from water-bearing zones of the Laramie-Fox and/or Upper Pierre Formations, which would occur during the approximate two year construction, drilling, and completion period. The cumulative amount of groundwater depletions would depend on the approved amount of development and depletions during field-wide and site-specific approvals and development for other present and reasonably foreseeable actions in the cumulative impact analysis area. When combined with the groundwater withdrawal from present and reasonably foreseeable actions, the pumping of 1,245 ac-ft of groundwater during the development period of the Proposed Action would contribute to a cumulative lowering of the water table during active pumping as well as over a period of time after pumping is halted (known as the recovery period).

Potential cumulative groundwater quality impacts are highly unlikely due to current regulations and practices and the predictable nature of drilling in the DJ Basin. In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in the need for additional water to drill and hydraulically fracture those wells. This could have a larger impact on water resources (quantity and quality) in the future.

3.5.6 Vegetation

The cumulative impact analysis area for vegetation resources is the Project Area. Cumulative impacts to vegetation resources would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). The removal and disturbance of vegetative cover from the Proposed Action in conjunction with cumulative projects would reduce soil productivity, and accelerate erosion for the lifetime of oil and gas production until final reclamation is deemed successful. Surface disturbance would also introduce or spread undesirable plant species which may reduce vegetative species biodiversity, and would fragment native vegetation communities and suitable plant habitats, which could affect seed dispersal and limit distribution of native plant species. Successful interim reclamation of well pads and associated infrastructure would result in approximately 141 acres of long-term surface disturbance in the Project Area. Final reclamation should result in the entirety of the lands being returned to the existing condition pending private landowner approval.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances that could have a larger impact to vegetation in the future.

3.5.7 Invasive Plants

The cumulative impact analysis area for invasive and noxious weeds is defined as the Project Area. Any surface-disturbing activity that removes native vegetation and topsoil from the Project Area may cumulatively and incrementally contribute to the introduction and/or spread of invasive and noxious species. Weed infestations may enter previously undisturbed areas, or increase the size or density of existing weed populations. These impacts would be expected to be greatest along road corridors, which are often a conduit for the spread of weeds. The Proposed Action would potentially facilitate the spread of invasive plants; however, implementation of a weed control plan would reduce cumulative impacts. The successful interim reclamation of well pads and associated infrastructure would reduce the long-term surface disturbance to 141 acres for the entire Project Area.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances that could increase the spread of invasive plants in the future.

3.5.8 General Wildlife

Big Game

The cumulative impact analysis area for big game species is GMU 88. Cumulative impacts to big game species would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to big game species would potentially include habitat fragmentation, habitat loss, loss of foraging opportunities, and animal displacement until successful reclamation is completed. Ongoing and reasonably foreseeable oil and gas activities could potentially lead to mortality due to vehicle collisions.

GMU 88 is the only GMU entirely within Weld County; GMU 87 is in Larimer and Weld counties, and GMU 89 is in Logan and Weld counties. Given the use of the area included in GMU 88 and Weld County for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to big game species would not be expected to substantially affect big game populations.

Raptors

The cumulative impact analysis area for raptor species including Swainson's hawk, red-tailed hawk, golden eagle, American kestrel, prairie falcon, great-horned owl, and short-eared owl is Weld County because these are wide-ranging species with large home ranges. Cumulative impacts to raptor species would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to raptor species would potentially include a reduced amount of available cover, foraging opportunities, habitat productivity, and breeding/nesting areas for these seven species until final reclamation is successful. Ongoing and reasonably foreseeable oil and gas activities would also increase human activities in Weld County, which could result in short-term or long-term site avoidance and could preclude raptors from using areas of more intensive human activity or result in nest abandonment if nests are established in the Project Area. The potential for collisions between raptors and vehicles would also increase. The severity of cumulative effects would depend on factors such as the sensitivity of the species affected, seasonal intensity of use, and the type of project activity.

Given the current use of Weld County for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to raptor species would not be expected to substantially affect raptor populations.

Other Wildlife Species

The cumulative impact analysis area for other terrestrial wildlife species (see Section 3.3.3 General Wildlife Affected Environment) is the Project Area. Cumulative impacts to other terrestrial wildlife species would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to these other wildlife species would potentially include loss and habitat fragmentation from surface-disturbing activities. Ongoing and reasonably foreseeable oil and gas activities would reduce cover and forage quality increase potential for mortality from predation and increased vehicular traffic. Indirect cumulative effects include increased establishment of invasive plant species which degrade foraging habitat for these other wildlife species.

Given the current use of the Project Area for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to other terrestrial wildlife species would not be expected to substantially affect other terrestrial wildlife populations.

3.5.9 Sensitive Species

Black-tailed Prairie Dog

Prairie dog coteries, or family groups, live within territories that are approximately one acre in size; therefore, the cumulative impact analysis area for black-tailed prairie dog is the Project Area (Koford 1958). Cumulative impacts to black-tailed prairie dogs would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to black-tailed prairie dogs would potentially include loss and habitat fragmentation through surface-disturbing activities. Ongoing and reasonably foreseeable oil and gas activities would reduce cover and forage quality, increase establishment of invasive plant species changing plant species composition and limiting suitable vegetation for prairie dog consumption, and increase potential for mortality from predation and increased vehicular traffic.

Given the current use of the Project Area for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to black-tailed prairie dogs would not be expected to substantially affect black-tailed prairie dog populations.

Swift Fox

Swift fox territory size varies with site, year, season, and gender; however, the average territory size of swift foxes based on some studies in Colorado is approximately 3,300 acres (Meyer 2009). Therefore, the cumulative impact analysis area is Weld County. Cumulative impacts to swift fox would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to swift fox would potentially include loss and habitat fragmentation through surface disturbing activities. Ongoing and reasonably foreseeable oil and gas activities would directly reduce cover and prey quantity, and increase potential for direct mortality from increased vehicular traffic.

Given the current use of Weld County for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to swift fox would not be expected to substantially affect swift fox populations.

Mountain Plover

Minimum area requirements for mountain plover broods are approximately 70 acres; therefore, the cumulative impact analysis area for mountain plover is the Project Area (Dinsmore 2003). Cumulative impacts to mountain plover would potentially result from initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to mountain plover would potentially include a reduced amount of available cover, foraging opportunities, habitat productivity, and breeding/nesting areas for mountain plover until final reclamation is successful. Ongoing and reasonably foreseeable oil and gas activities would also increase human activities in the Project Area, which could result in short-term or long-term site avoidance and could preclude mountain plover from using areas of more intensive human activity. The potential for collisions between mountain plovers and vehicles would also increase.

Given the current use of the Project Area for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to mountain plover would not be expected to substantially affect mountain plover populations.

Ferruginous Hawk

The cumulative impact analysis area for ferruginous hawk is Weld County. Cumulative impacts to ferruginous hawk would potentially result from initial surface disturbance of approximately 305 acres which would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). Direct cumulative impacts to ferruginous hawk would include potential for reduction in prey base due to the disturbance of prairie dog colonies, and site avoidance because ferruginous hawk have a relatively high sensitivity to human disturbance (Suter and Jones 1981).

Given the current use of Weld County for oil and gas development and existing levels of habitat fragmentation and human activity, incremental cumulative impacts to ferruginous hawk would not be expected to substantially affect ferruginous hawk populations.

3.5.10 Migratory Birds

The cumulative impact analysis area for BLM Priority and Colorado Partners in Flight Birds of Conservation Concern migratory bird species is Weld County. Cumulative impacts to migratory bird species would potentially result in initial surface disturbance of approximately 305 acres of initial surface-disturbance on private lands which would be reclaimed to a total long-term disturbance of approximately 141 acres. The Proposed Action would incrementally increase the estimated 44,440 acres of cumulative disturbance from past, present, and reasonably foreseeable oil and gas activity in the RGFO (BLM 2012a). The Proposed Action would cumulatively reduce the amount of available cover, foraging opportunities, habitat productivity, and breeding/nesting areas for migratory birds (see Table 3-8) until successful final reclamation. The successful reclamation of well pads and associated infrastructure would reduce the long-term surface disturbance to 141 acres in the Project Area. Human activities would result in short-term or long-term site avoidance, or would preclude migratory birds from using areas of more intensive human activity and could increase the potential for collisions between birds and vehicles. The severity of cumulative effects would depend on factors such as the sensitivity of the species affected, seasonal intensity of use, type of project activity, and physical parameters (e.g., topography, forage, and cover availability).

3.5.11 Threatened, Endangered, and Proposed Species

The cumulative impact analysis area for threatened, endangered, and proposed species is the Platte River Basin. There are no proposed species in the Project Area. Cumulative impacts to threatened and endangered species would result in approximately 1,245 ac-ft of water depletions and combined with other past, present, and reasonably foreseeable future projects, would reduce the volume of water within the Platte River Basin. As a result, implementation of the Proposed Action, in combination with other oil and gas activities in the region, would degrade habitat for the whooping crane, interior least tern, Great Plains population of the piping plover, pallid sturgeon, and western prairie-fringed orchid.

Cumulative effects to threatened and endangered species resources within the Platte River Basin would primarily be associated with increased potential for erosion and sedimentation in the Platte River Basin and water depletions associated with existing and continued oil and gas developments. Deteriorated waterways due to erosion and sedimentation increases would affect pallid sturgeon spawning habitat; the foraging and nesting habitats for whooping crane, interior least tern, and piping plover; and degradation of the western prairie-fringed orchid suitable habitat of mesic and wet prairies and meadows.

3.5.12 Cultural Resources

The cumulative impact analysis area for cultural resources is the Project Area. One historic property defined as eligible for the NRHP was observed during the cultural resources inventory (5WL7780). The surface ownership is private and is still occupied by the owners. The Proposed Action would have no cumulative effect on any historic properties in, or near the Project Area unless the surface owner allows activities associated with the proposed undertaking of the historic property.

3.5.13 Native American Religious Concerns

The cumulative impact analysis area for Native American religious concerns is the Project Area. No properties of concern to the tribes were identified during consultation; therefore, no cumulative effects as a result of the Proposed Action are anticipated.

3.5.14 Paleontological Resources

The cumulative impact analysis area for paleontological resources is defined as the Project Area. Cumulative impacts to paleontological resources are defined as any damage to, or destruction of, paleontological resources which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions (40 CFR 1508.7). Impacts to paleontological resources would primarily result from past, present, and reasonably foreseeable activities associated with surface and subsurface disturbance of fossiliferous rocks for oil and gas development. These activities could damage or destroy fossils. Due to the remote nature of the Project Area, it is not anticipated that the Proposed Action would result in increased visitation to the area; therefore, increased vandalism and theft of fossils is not anticipated to be an issue.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances that could have a larger impact on paleontological resources in the future.

3.5.15 Socioeconomic Resources

The cumulative impact analysis area for socioeconomic resources is Weld County. Cumulative impacts to socioeconomic resources would incrementally increase the beneficial effects of socioeconomic resources due to oil and gas development projects that are planned or on-going in Weld County. Cumulative effects include increased payments received from the leasing of federal mineral estate, as well as indirect effects such as increased employment opportunities in industries related to the oil and gas sector and economic benefit to federal, state, and county governments related to lease payments, royalty payments, severance taxes, and property taxes. The proposed project is located in Weld County, Colorado, which has approximately 25,000 active petroleum wells (COGCC 2015a). The majority of these wells are located on privately owned surface and produce privately owned minerals. The Proposed Action's contribution to this beneficial effect would be moderate with the addition of 89 wells when added to the cumulative impacts of other oil and gas projects within Weld County.

In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could have a larger impact on socioeconomic resources in the future.

3.5.16 Visual Resources

The cumulative impact analysis area for visual resources is the Project Area. Cumulative impacts to visual resource would incrementally increase when added to past, present, and reasonably foreseeable oil and gas activity in the Project Area due to ongoing oil and gas exploration and production. In the long term, if economical quantities of oil and gas are found, additional wells can be expected to be drilled in the area, which could result in greater surface disturbances and construction of additional infrastructure that could have an adverse impact on visual resources in the future. Given that there are few residences near the Project Area and the limited public access to the PNG in this area, cumulative impacts to observers are would be minimal. Additionally, Noble's consolidated design and commitment to painting facilities a neutral, non-reflective color would help minimize cumulative impacts.

3.5.17 Noise

The cumulative impact analysis area for noise is the Project Area. Cumulative impacts to noise would incrementally increase noise when added to past, present, and reasonably foreseeable oil and gas activity in the Project Area due to ongoing oil and gas exploration and production. Given that there are few residences near the Project Area (see Section 3.4.6 Noise) and Noble's adherence to noise ordinances, the cumulative effects would be minimal relative to overall noise increases within Weld County from other projects.

3.5.18 Wastes, Hazardous or Solid

The cumulative impact analysis area for wastes, hazardous or solid, is the Project Area. Cumulative impacts to wastes would incrementally increase waste generation from past, present, and reasonably foreseeable future actions from oil and gas exploration and production; however, adherence to regulatory requirements and BMPs adopted by Noble as described in Section 3.4.7 Wastes, Hazardous or Solid, would minimize cumulative environmental and safety effects from hazardous or solid waste use and disposal.

3.5.19 Transportation and Access

The cumulative impact analysis area for transportation and access is Weld County. Cumulative impacts to transportation and access would result in an initial surface disturbance of 23.8 acres due to new road construction and road improvements, and would also result in an increase in traffic with 261 light truck trips per well and 193 heavy truck trips per well anticipated in the short-term during construction, drilling, and completions (see Table 3-12), and an increase in traffic during the long-term (30-year production phase) with 730 light truck trips per well per year and 402 heavy truck trips per well per year (see Table 3-13) (see Section 3.4.8 Transportation and Access).

Cumulative effects to transportation and access in the Project Area would be associated with increased traffic and congestion in roads providing access to and through the Project Area, increased potential for vehicular accidents and collisions with livestock and wildlife, increased access of humans to the Project Area and surrounding private lands due to in creation of new roads and improvement of existing roads, and the degradation of existing roadways leading to and through the Project Area. Cumulative effects would also incrementally increase waste generation from past, present, and reasonably foreseeable future actions from oil and gas exploration and production.

CHAPTER 4 – CONSULTATION AND COORDINATION

4.1 Interdisciplinary Team Reviewers and List of Preparers

The following list of ID Team members participated in the project kickoff meeting; only those with resources analyzed in the EA participated in the review and completion of the document.

BLM ID Team Reviewers

ID Team Member	Resource Reviewed/Position
Jay Raiford	Assistant Field Manager, Nonrenewable Resources
Martin Weimer	District NEPA Coordinator
Aaron Richter	BLM Project Manager, Water, Soils, Prime and Unique Farmlands
Lara Duran	Wildlife
John Lamman	Vegetation and Invasive Species
Dave Gilbert	Riparian/Wetlands and Aquatic Wildlife
Forrest Cook and Chad Meister	Air Quality
Monica Weimer	Cultural and Native American Resources
Melissa Smeins	Geology, Minerals, Paleontology
Linda Skinner	Visual Resources and Recreation

List of Preparers

Name	Company	Area(s) of Participation
Lisa Sakata	ICF International	Project Manager, EA preparation, NEPA review Visual Resources
David Ernst	ICF International	Air Quality
Kristin Salamack	ICF International	Wildlife, Vegetation, Invasive Species, T&E Species, Migratory Birds, Wastes, and Noise
Alex Bartlett	ICF International	Geology, Mineral, Soils, Water, and Paleontology

List of Preparers

Name	Company	Area(s) of Participation
Lissa Johnson	ICF International	GIS analysis and map production
Madeline Terry	ICF International	QA/QC
Karen DiPietro	ICF International	Document preparation

4.2 Tribes, Individuals, Organizations, or Agencies Consulted

- Apache Tribe of Oklahoma
- Cheyenne and Arapaho Tribes of Oklahoma
- Cheyenne River Sioux Tribe
- Comanche Tribe of Oklahoma
- Crow Creek Sioux
- Eastern Shoshone
- Jicarilla Apache Nation
- Kiowa Tribe of Oklahoma
- Northern Arapaho Tribe
- Northern Cheyenne Tribe
- The Ute Tribe
- Oglala Sioux Tribe
- Pawnee Tribe
- Rosebud Sioux Tribe
- Southern Ute Tribe
- Standing Rock Lakota Tribe
- Ute Mountain Ute Tribe
- State Historic Preservation Office, Colorado
- Advisory Council on Historic Preservation

CHAPTER 5 – REFERENCES

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APPENDIX A. INTERDISCIPLINARY TEAM CHECKLIST

Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Air Quality *Chad Meister, Forrest Cook*		X	• Emissions inventory developed specifically for the proposed Project was based on detailed data obtained from Noble and the Project-specific emissions inventory provides reasonable estimates of the regional and local air quality impacts for the proposed project. • The Project-specific air quality impact analysis will be based directly on the magnitude of criteria and hazardous air pollutants (HAPs) emissions for the Project. Near-field dispersion modeling will be performed for multiple scenarios including conservative analyses of impacts for construction / development and production activities. The proposed wells are in an ozone attainment area; however, they are just one mile north of a nonattainment area. • Near-field development and production scenarios modeling analysis will include HAPs and criteria (NO_2 and PM) pollutants impacts at nearest resident receptors. • Include BLM CARMMS results for addressing regional ozone and other pollutant impacts, and air quality related values (AQRV) impacts including visibility degradation and annual deposition at Rocky Mountain National Park. • Include GHGs and Climate Change information. • Include mitigation section that will be based on information including Project-specific modeling results and other factors such as proximity to ozone non-attainment boundary, etc.	FC, 07/08/2014 Updated 03/30/2015 (FC)
Geology/Minerals *Melissa Smeins*		X	• Surface disturbance estimates are based on the best available information. • Leaseholders have the right to explore, develop, and produce mineral resources from any valid, existing lease. Must coordinate with other mineral interest holders in the area, i.e. mining claimants if applicable. • The analysis area for geology and mineral resources is the project area. Include other leasable minerals and salable minerals within the project area and vicinity (10-mile radius). • Review geologic data from BLM; assess how the patterns and extent of surface disturbances would alter existing topography and increase geologic hazard potential. • Review geologic data from Noble.	Mjs, 6/23/2014 MJS 3/31/2015

Noble East Pony Project EA
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Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Soils *John Smeins*		X	• Categorize soils types in the project area using NRCS data. • Generally discuss surface disturbance and erosion of surface soils. Refer to reclamation plan. • Include language about the state's stormwater management plan/permit requirements; reference Noble-provided stormwater plan. • All infrastructure (roads, drill pads, etc.) being proposed would be built and reclaimed according to BLM Gold Book standards unless otherwise stipulated by the surface owner. • Discuss three-year storm events; evaluate and document whether infrequent standing water habitat ("playas") are in the vicinity.	JS, 6/13/2014 AR, 3/30/2015
Water Resources Surface and Ground *John Smeins*		X	• Include a description of groundwater resources/ wells within one-mile of proposed activities. Include information for surface and bottom hole locations. • Include a description of surface waters within the project area and proximity to proposed activities. • Include detail about water management – sources and disposal. • Include discussion of anticipated water volumes – fresh, flowback, and produced per well. • Discuss potential depletions to the Platte River basin, if applicable. • Chemicals used for production drilling could cause local contamination of soils and groundwater if not managed properly. By design, the BLM approves APDs and associated drilling plans to protect groundwater. • Include descriptions of any geologic and/or engineering reviews to ensure protection of all downhole resources. Onshore Order #2. • Chemicals used for production drilling (hydraulic fracturing) could cause local contamination of groundwater if not managed properly. Discuss the treatment facility process for flow back or produced water and UIC permitted waste water conditions. By design, the BLM approves APDs and associated drilling plans to protect groundwater. • Construction of well pads, proper disposal practices, proper well casing and	JS, 6/13/2014 AR 3/30/2015 Make sure to talk briefly about SPWRAP if talking about depletions to the Platte. SPWRAP will be mentioned in the T&E section as well.

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Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
			cementing, and closed loop system would be in accordance with BLM guidelines and should minimize adverse effects on groundwater quality.	
Invasive Plants *John Lamman*		X	• Resources present; however, the project area is in private surface ownership that is not managed by BLM. • County weed management applies; however, BLM will not enforce.	JL, 06/11/2014 JL, 03/25/2014
T&E Species – Vegetation and Wildlife *Matt Rustand* *Lara Duran*		X	• Use the best available data to determine the presence of T&E plant and wildlife species in or within 100 feet of the Project Area for BLM RGFO and NFS Pawnee NG. • Determine if proposed water sources are tributary to the South Platte River basin (Colorado water court determinations pending). • Determine whether any water depletions could impact T&E species downstream of the project area for BLM RGFO and NFS Pawnee NG. • Refer to the Programmatic Biological Opinion for SPWRAP or show non-tributary source of water. • If BLM and USFWS determine that there would be depletions to the South Platte River basin, consult with FWS under recently issued programmatic BO. • Lease stipulations that may be in place are to be imposed, if applicable.	MR, 7/7/2014 LD, 4/2/15
Sensitive Species – Vegetation and Wildlife *Matt Rustand* *Lara Duran*		X	• The project area is in private surface ownership that is not managed by BLM. • Use the best available data to determine the presence of BLM RGFO and NFS Pawnee NG sensitive plant and wildlife species in and within 100 feet of the Project Area. • Determine the impacts to BLM RGFO & NFS Pawnee NG plant species within 100 feet of the project area. • Determine the impacts to BLM RGFO & NFS Pawnee NG wildlife species within ¼ mile of the project area • Include analysis for management Indicator Species in Pawnee National Grassland for those species within ¼ mile of the project area	LD, 4/2/15
Vegetation *John Lamman*		X	• Resources present; however, the project area is in private surface ownership that is not managed by BLM; briefly discuss existing condition of vegetation.	JL, 06/11/2014 JL, 03/25/2014

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Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Wetlands and Riparian *Dave Gilbert*	X		• Proposal is located in upland shortgrass prairie; resources are not present within the project area. • Igo Creek is > 0.5 miles from any proposed activity.	DG, 7,7/14 DG, 3/19/15
Wildlife Aquatic *Dave Gilbert*	X		• Proposal is located in uplands; no aquatic wildlife habitat is present.	DG, 7,7/14 DG, 3/19/15
Wildlife Terrestrial *Matt Rustand*		X	• Resources present; however, the project area is in private surface ownership that is not managed by BLM; briefly discuss existing condition and the effects to species • Stipulations attached to the lease are still to be imposed (i.e. big game winter range, bald eagle roost sites, etc.).	MR, 7/7/2014 LD, 4/2/15
Migratory Birds *Matt Rustand*		X	• Compliance with Migratory Bird Treaty Act (MBTA) and the Memorandum of Understanding between BLM and USFWS required by Executive Order 13186 requires avoidance of "take." • Project area is within BCR-18 Shortgrass Prairie • Obtain migratory bird species list from RGFO wildlife biologist	MR, 7/7/2014 LD, 4/2/15
Cultural Resources *Monica Weimer*		X	• Landowners have allowed access for cultural resource surveys. • BLM archaeologist will review survey reports, draft cultural resources section, and initiate consultation with SHPO. • Protection of cultural resources will be in accordance with State Historic Preservation Office (SHPO) coordination requirements; input from local publics, other interested parties, and Native American groups; and applicable federal regulations. • Because some of the cultural resources inventory buffers will include land within the Pawnee National Grassland, BLM will coordinate the Section 106 process for the new inventory with the Forest Service.	BLM will complete Section 106 process. As with the other NEPA dox, Monica will provide the writeup. NA contact covered under the Weld County consultation. MMW, 6/10/14 MMW, 4/2/15
Native American Religious Concerns *Monica Weimer*		X	• BLM archaeologist will initiate tribal consultation and will draft this section based on comments received.	MMW, 6/30/14 MMW, 4/2/15

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Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Economics *Martin Weimer*		X	• Briefly describe the geographic extent/area of potential economic effects (Weld County). • Minimal impact to the social or economic status of the county or nearby communities expected due to its small size in relation to ongoing development throughout the area and the rural nature of the area. • Address fiscal impacts such as severance tax, gross products tax, sales tax, and federal mineral royalties; the project may generate federal, state, and county royalty and tax revenues, PILT payments.	Mw, 7/7/14
Paleontology *Melissa Smeins*		X	• Briefly discuss existing condition using BLM-provided PFYC classification and data. If class 3, 4, 5 paleo resources, mitigation may be required prior to or during surface disturbing activities unless waiver is signed by private landowners.	Mjs, 6/23/2014 MJS 3/31/2015
Visual Resources *Kalem Leonard* *Linda Skinner*		X	• Due to the scale of the project impacts to visual resources need to be analyzed. • The project area is in private surface ownership and BLM VRM classifications do not apply; however, analysis is based upon changes from current conditions. • Describe USFS SIOs and associated management due to proximity to PNG. Coordinate with USFS and use information from the recently completed visual analysis for the USFS PNG Oil and Gas Leasing EIS.	KL, 6/18/2014 LS, 3/31/15
Environmental Justice *Martin Weimer*	X		• The proposed action would affect areas that are rural in nature. As such, the proposal would not have a disproportionately high or adverse environmental effect on minority or low-income populations.	Mw, 7/7/14
Wastes Hazardous or Solid *Melissa Smeins*		X	• Not likely to be present – BLM assumes that conditions associated with the project area (surface and subsurface) are currently clean and there is no known contamination. • Include description of water and waste disposal sites; reference the Hazardous Materials and Solid Waste Management Plan. • No treatment or disposal of wastes on site is allowed on Federal Lands.	Mjs, 6.23.2014 MJS 3/31/2015
Recreation *Kalem Leonard* *Linda Skinner*	X		• Resources are not present; the project area is in private surface ownership that is not managed by BLM with no access and no recreation opportunities.	KL, 6/18/2014 LS, 3/31/15

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Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Farmlands Prime and Unique *John Smeins*		X	• Resources are not present within the project area because identified areas are not irrigated (RGFO RMP and NRCS). • Farmlands of statewide importance are present (NRCS).	JS, 6/13/2014 AR, 3/30/2015
Lands and Realty	X		• Resources are not present; the project area is in private surface ownership that is not managed by BLM.	N/A (AR)
Wilderness, WSAs, ACECs, Wild & Scenic Rivers *Kalem Leonard* *Linda Skinner*	X		• Resources are not present within the project area (RGFO RMP).	KL, 6/18/2014 LS 3/31/15
Wilderness Characteristics *Kalem Leonard* *Linda Skinner*	X		• Resources are not present within the project area (RGFO RMP).	KL, 6/18/2014 LS, 3/31/15
Range Management *John Lamman*	X		• Resources are present; however, the project area is in private surface ownership that is not managed by BLM. • There are no relevant BLM allotments, leases, or range improvements to discuss.	JL, 06/11/2014 JL, 03/25/2014
Forest Management *Ken Reed*	X		• No forest resources are present in the project area, which is native shortgrass prairie; private surface ownership.	N/A (AR)
Cadastral Survey *Jeff Covington*	X		• Per onshore order #1, operators are required to submit a plat of each well, drawn by a licensed surveyor. BLM reviews the plats before APD is approved.	AR, 4/2/2015
Noise *Martin Weimer*		X	• Potential effects will occur during construction and operation. • County/state noise ordinances apply; however, BLM will not enforce. • Certain levels of noise are associated with drilling operations, these include drill rig operation, compressors/ generators and general machine and vehicle operation. These impacts are temporary and terminate when drilling operations are complete.	Mw, 7/7/14 Mw, 4/2/15
Fire *Bob Hurley*	X		• Resources are not present; the project area is in private surface ownership that is not managed by BLM	N/A (AR)

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Noble East Pony Project EA
ID Team Checklist and Resource Approach Summary
April 16, 2015

Resource	Not Analyzed in the EA	To be Analyzed in the EA	Methodology and Assumptions for Analysis or Rationale for Dismissal	BLM Specialist Initials/Date/ Comments
Law Enforcement *Steve Cunningham*	X		• The project area is in private surface ownership that is not managed by BLM	N/A (AR)
Access and Transportation *Aaron Richter*		X	• Potential effects will occur during construction and operation. • New roads and road improvements are part of the proposed project	AR, 4/16/15

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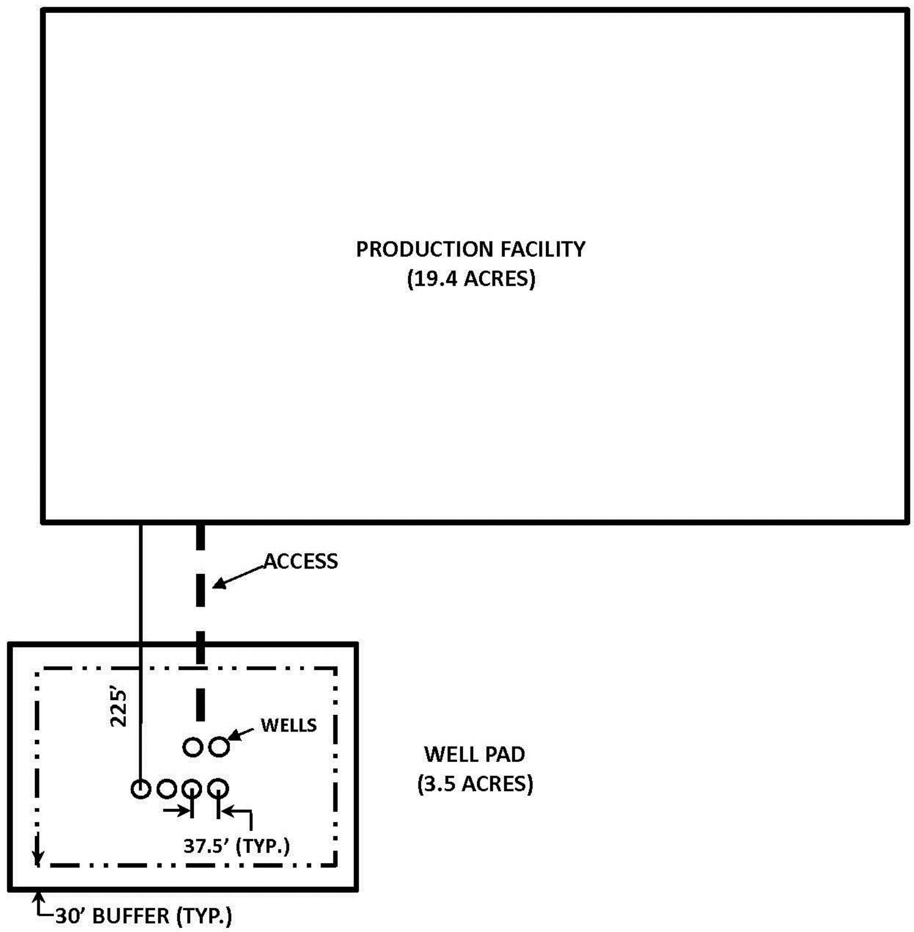
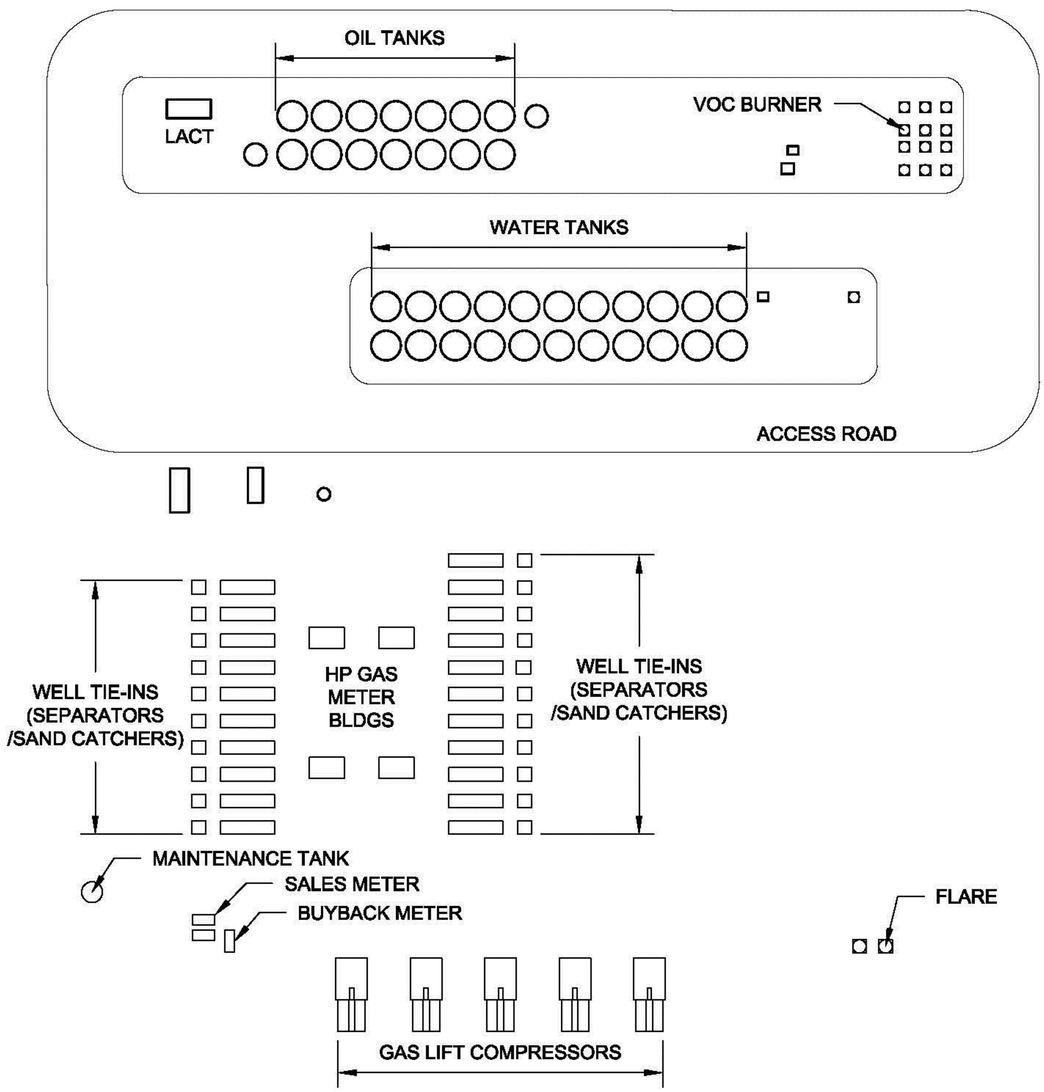
APPENDIX B. TYPICAL WELL PAD AND ECONODE LAYOUTS

TYPICAL WELL PAD (6 wells shown)





TYPICAL ECONODE LAYOUT

APPENDIX C. AIR QUALITY SUPPLEMENTAL INFORMATION

APPENDIX C-1

EMISSIONS INVENTORY CALCULATIONS

This appendix provides the air pollutant emission inventory prepared by Noble Energy, Inc. to support the EA for the proposed wells and associated infrastructure. Emissions of criteria air pollutants, hazardous air pollutant, and greenhouse gases were inventoried. Development of the lease could lead to surface disturbance from the construction of well pads, EcoNodes, access roads, pipelines, and power lines, as well as associated air pollutant emissions from windblown dust and equipment and vehicle exhaust. The analysis includes construction emissions (well pad and infrastructure construction), drilling emissions, completion emissions, and production emissions (vehicle traffic and on-site equipment). The emission inventory was developed using reasonable but conservative scenarios developed by Noble Energy for each activity. Production emissions were calculated based on full production activity. Relevant assumptions are provided in each section.

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Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Noble DP East Pony 205/206 EA Annual Emissions Summary (tons/yr) - Proposed Action [a]

		Criteria Pollutant Emissions					
	Source ID	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$
Development Emissions	Construction	3.9	1.8	0.2	0.002	4.3	1.0
	Drilling	53.5	80.8	21.7	0.1	51.5	9.5
	Completion	40.2	41.0	9.0	0.05	50.0	8.8
	Interim Reclamation	0.1	0.1	0.01	0.0001	0.4	0.1
	Wind Erosion	---	---	---	---	13.9	2.1
EcoNode Emissions	Production Heaters	28.7	24.1	1.6	0.2	2.2	2.2
	Storage Tanks	---	---	191.6	---	---	---
	Fugitives	---	---	6.0	---	---	---
	Pneumatics	---	---	0.0	---	---	---
	Generators	10.5	21.0	7.4	0.02	0.8	0.8
	Truck Loading	---	---	0.7	---	---	---
	Engines	514.5	1,029.0	360.1	1.1	20.3	20.3
	Wellsite Flares	7.1	38.4	1.1	0.1	1.5	1.5
	Wind Erosion	---	---	---	---	4.0	0.6
	Operations Vehicle	68.4	16.3	2.1	0.051	133.8	21.8
	Total Emissions	**726.8**	**1,252.4**	**601.5**	**1.6**	**282.5**	**68.5**

[a] Emissions in summary tables may vary slightly due to rounding differences.

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Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Development Emissions Summary

Pollutant	Development Emissions (tons/year)[a,b]					Total
	Construction	Drilling[c]	Completion[c]	Interim Reclamation	Wind Erosion	(tons/yr)
Criteria Pollutants & VOC						
NO_X	3.9	53.5	40.2	0.1	---	97.7
CO	1.8	80.8	41.0	0.1	---	123.6
VOC	0.2	21.7	9.0	0.01	---	31.0
SO_2	0.002	0.1	0.05	0.0001	---	0.1
PM_{10}	4.3	51.5	50.0	0.4	13.9	120.0
$PM_{2.5}$	1.0	9.5	8.8	0.1	2.1	21.4
Hazardous Air Pollutants						
Benzene	---	0.17	0.06	---	---	0.23
Toluene	---	0.06	0.022	---	---	0.08
Ethylbenzene	---	0.0027	0.0010	---	---	0.0036
Xylene	---	0.021	0.008	---	---	0.029
Formaldehyde	---	2.19	0.81	---	---	3.00
1,1,2,2-Tetrachloroethane	---	0.0027	0.0010	---	---	0.0037
1,1,2-Trichloroethane	---	0.0016	0.0006	---	---	0.0022
1.3-Butadiene	---	0.07	0.026	---	---	0.10
1,3-Dichloropropene	---	0.0014	0.0005	---	---	0.0019
Acetaldehyde	---	0.30	0.11	---	---	0.41
Acrolein	---	0.28	0.10	---	---	0.38
Carbon Tetrachloride	---	0.0019	0.0007	---	---	0.0026
Chlorobenzene	---	0.0014	0.0005	---	---	0.0019
Chloroform	---	0.0015	0.0005	---	---	0.0020
Ethylene Dibromide	---	0.0023	0.0008	---	---	0.0031
Methanol	---	0.33	0.12	---	---	0.45
Methylene Chloride	---	0.0044	0.0016	---	---	0.006
Naphthalene	---	0.010	0.0038	---	---	0.014
PAH	---	0.015	0.006	---	---	0.021
Styrene	---	0.0013	0.00047	---	---	0.0017
Vinyl Chloride	---	0.0008	0.00028	---	---	0.0011
Greenhouses Gases						
CO_2	319.0	15,651	8,151	14	---	24,134
CH_4	0.0050	0.32	0.16	0.00026	---	0.48
N_2O	0.0015	0.054	0.033	0.00008	---	0.09
CO_2e	692.0	20,242	8,164	14	---	29,112

a Assumes maximum development scenario of 89 wells in one year
b Emissions in summary tables may vary slightly due to rounding differences.
c Total drilling and completion emissions includes LNG/NG drill rig engines

KLEINFELDER

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year)[a,b]										
	Production Heaters	Production Compressors	Storage Tanks	Production Generator	Pneumatics	Truck Loading	Fugitive Emissions	Production Flares	Wind Erosion	Operations Vehicle	Total (tons/year)
Criteria Pollutants & VOC											
NO_X	28.7	514.5	---	10.5	---	---	---	7.1	---	68.4	629.1
CO	24.1	1029.0	---	21.0	---	---	---	38.4	---	16.3	1,128.7
VOC	1.6	360.1	191.6	7.4	0.0	0.7	6.0	1.1	---	2.1	570.5
SO_2	0.2	1.1	---	0.02	---	---	---	0.1	---	0.1	1.5
PM_{10}	2.2	20.3	---	0.8	---	---	---	1.5	4.0	133.8	162.5
$PM_{2.5}$	2.2	20.3	---	0.8	---	---	---	1.5	0.6	21.8	47.1
Hazardous Air Pollutants											
Benzene	0.00060	0.49	1.69	0.031	0.00	---	0.01	0.00042	---	---	2.23
Toluene	0.0010	0.40	---	0.011	0.00	---	0.00	0.00068	---	---	0.42
Ethylbenzene	---	0.037	---	0.00048	0.000	---	0.000	---	---	---	0.04
Xylene	---	0.18	---	0.0038	0.000	---	0.001	---	---	---	0.18
n-Hexane	0.52	0.99	9.50	---	0.00	---	0.06	0.36	---	---	11.42
Formaldehyde	0.021	48.42	---	0.40	---	---	---	0.015	---	---	48.86
Acetaldehyde	---	7.64	---	0.055	---	---	---	---	---	---	7.69
Acrolein	---	4.76	---	0.051	---	---	---	---	---	---	4.81
Methanol	---	2.43	---	0.060	---	---	---	---	---	---	2.49
1,1,2,2-Tetrachloroethane	---	0.037	---	0.00049	---	---	---	---	---	---	0.038
1,1,2-Trichloroethane	---	0.029	---	0.00030	---	---	---	---	---	---	0.030
1,3-Dichloropropene	---	0.024	---	0.00025	---	---	---	---	---	---	0.025
1,3-Butadiene	---	0.28	---	0.013	---	---	---	---	---	---	0.29
2,2,4-Trimethylpentane	---	0.22	---	---	---	---	---	---	---	---	0.22
Biphenyl	---	0.19	---	---	---	---	---	---	---	---	0.19
Carbon Tetrachloride		0.034		0.00035							0.034
Chlorobenzene	---	0.028	---	0.00025	---	---	---	---	---	---	0.028
Chloroform	---	0.026	---	0.00027	---	---	---	---	---	---	0.027
Ethylene Dibromide	---	0.041	---	0.00042	---	---	---	---	---	---	0.041
Methylene Chloride	---	0.021	---	0.00080	---	---	---	---	---	---	0.021
Dichlorobenzene	0.00034	---	---	---	---	---	---	---	---	---	0.00034
Naphthalene	0.00017	0.073	---	0.0019	---	---	---	---	---	---	0.07
Phenol	---	0.021	---	---	---	---	---	---	---	---	0.021
Styrene	---	0.022	---	0.00023	---	---	---	---	---	---	0.022
Tetrachloroethane	---	0.0022	---	---	---	---	---	---	---	---	0.002
Vinyl Chloride	---	0.014	---	0.00014	---	---	---	---	---	---	0.014
PAH -POM 1	---	0.033	---	0.0028	---	---	---	---	---	---	0.036
POM 2	0.000017	0.053	---	---	---	---	---	---	---	---	0.05
POM 3	0.0000046	---	---	---	---	---	---	---	---	---	0.00000459
POM 4	0.00000052	---	---	---	---	---	---	---	---	---	0.00000052
POM 5	0.00000069	---	---	---	---	---	---	---	---	---	0.00000069
POM 6	0.0000021	0.00015	---	---	---	---	---	---	---	---	0.00015
POM 7	0.00000052	0.00062	---	---	---	---	---	---	---	---	0.00062
Greenhouse Gases											
CO_2	34,200	223,854	---	4582	0.27	---	38.2	12,178	---	7,400	282,252
CH_4	0.64	4.22	---	0.086	0.00	---	391.07	0.23	---	0.077	396
N_2O	0.064	0.42	---	0.0086	---	---	---	0.023	---	0.0091	0.53
CO_2e	34,235	224,085	---	4587	0	---	9,815	12,191	---	7,405	292,318

a Assumes maximum development scenario of 89 oil and gas wells

b Emissions in summary tables may vary slightly due to rounding differences.

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Total Project Emissions Summary

Pollutant	Project Emissions (tons/year) [a,b]		Total Emissions (tons/year)
	Development	Production	
Criteria Pollutants & VOC			
NO_X	97.7	629.1	726.8
CO	123.6	1,128.7	1,252.4
VOC	31.0	570.5	601.5
SO_2	0.1	1.5	1.6
PM_{10}	120.0	162.5	282.5
$PM_{2.5}$	21.4	47.1	68.5
Hazardous Air Pollutants			
Benzene	0.23	2.23	2.46
Toluene	0.082	0.42	0.50
Ethylbenzene	0.0036	0.038	0.041
Xylene	0.029	0.18	0.21
n-Hexane	---	11.42	11.42
Formaldehyde	3.00	48.86	51.86
Acetaldehyde	0.41	7.69	8.10
Acrolein	0.38	4.81	5.19
Methanol	0.45	2.49	2.94
1,1,2,2-Tetrachloroethane	0.0037	0.038	0.042
1,1,2-Trichloroethane	0.0022	0.030	0.032
1,3-Dichloropropene	0.0019	0.025	0.026
1,3-Butadiene	0.097	0.29	0.39
2,2,4-Trimethylpentane	---	0.22	0.22
Biphenyl	---	0.19	0.19
Carbon Tetrachloride	0.0026	0.034	0.037
Chlorobenzene	0.0019	0.028	0.030
Chloroform	0.0020	0.027	0.029
Dichlorobenzene	---	0.00034	0.0003
Ethylene Dibromide	0.0031	0.041	0.044
Methylene Chloride	0.0060	0.021	0.027
Naphthalene	0.014	0.07	0.089
Phenol	---	0.021	0.021
Styrene	0.0017	0.022	0.024
Tetrachloroethane	---	0.0022	0.0022
Vinyl Chloride	0.0011	0.014	0.015
(PAH) POM 1	0.021	0.036	0.056
POM 2	---	0.053	0.053
POM 3	---	0.0000046	0.0000046
POM 4	---	0.0000005	0.00000052
POM 5	---	0.0000007	0.00000069
POM 6	---	0.00015	0.00015
POM 7	---	0.0006	0.00062
Total HAPs	4.74	79.31	84.05
Greenhouse Gases			
CO_2	24,134	282,252	306,386
CH_4	0.48	396	397
N_2O	0.089	0.53	0.62
CO_2e	29,112	292,318	321,429

a Emissions for Peak Field Development
b Emissions in summary tables may vary slightly due to rounding differences.

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Modeling Emissions Summary

Construction Emissions

Pollutant	Well Pad and EcoNode Constuction Emissions [a]			
	Average Well Pad Construction		Average EcoNode Construction	
	lb/hour	tons/year	lb/hour	tons/year
NO_X	2.51	1.08	2.51	0.35
CO	0.81	0.37	0.81	0.12
VOC	0.20	0.094	0.20	0.030
PM_{10}	0.50	0.47	0.50	2.33
$PM_{2.5}$	0.33	0.13	0.33	0.39

a Annual emissions include pad construction equipment and wind erosion. Hourly emissions from construction equipment assumes one piece of equipment operating at a time and no wind erosion. Construction of roads and pipeline segments averaged in with EcoNodes. Construction emissions only occur for 12 hours per day

Pollutant	Well Pad and EcoNode Road Construction Travel Emissions [a]			
	Average Well Pad Construction		Average EcoNode Construction	
	lb/hour	tons/year	lb/hour	tons/year
NO_X	2.58	0.11	4.23	0.18
CO	1.11	0.048	3.42	0.14
VOC	0.10	0.0045	0.25	0.011
SO_2	0.0022	0.00010	0.0048	0.00020
PM_{10}	3.87	0.15	9.89	0.33
$PM_{2.5}$	0.65	0.021	1.40	0.050

a Emissions include fugitive dust from vehicle traffic during construction and tailpipe emissions from trucks along the entire round trip mileage. Construction emissions only occur for 12 hours per day

Drilling Emissions

Pollutant	Drill Rig Emissions	
	Single Well Emissions [a]	
	lb/hour	tons/year
NO_X	2.65	0.32
CO	5.29	0.63
VOC	1.85	0.22
PM_{10}	0.19	0.023
$PM_{2.5}$	0.19	0.023
SO_2	0.0058	0.00069
Acetaldehyde	0.027	0.0033
Acrolein	0.026	0.0031
Formaldehyde	0.20	0.024
Methanol	0.030	0.0036
n-Hexane	----	----
Benzene	0.016	0.0019
Ethylbenzene	0.00024	0.000029
Toluene	0.0055	0.00066
Xylenes	0.0019	0.00023

a Annual emissions assume 10 days to drill each well. Drilling occurs 24 hours/day.

Pollutant	Road Travel from Drilling [a]	
	Single Well Emissions	
	lb/hour	tons/year
NO_X	2.28	0.27
CO	2.14	0.26
VOC	0.15	0.018
SO_2	0.0028	0.00033
PM_{10}	5.67	0.55
$PM_{2.5}$	0.81	0.083

a Emissions include fugitive dust from vehicle traffic during drilling and tailpipe emissions from trucks along the entire round trip mileage

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Completion Emissions

Pollutant	Completion Rig Emissions [a] Single Well Emissions lb/hour	tons/year
NO_X	9.92	0.12
CO	19.84	0.24
VOC	6.94	0.083
PM_{10}	0.72	0.0086
$PM_{2.5}$	0.72	0.0086
SO_2	0.02	0.00026
Acetaldehyde	0.10	0.0012
Acrolein	0.097	0.0012
Formaldehyde	0.76	0.0091
Methanol	0.11	0.0014
n-Hexane	----	----
Benzene	0.058	0.00070
Ethylbenzene	0.00092	0.000011
Toluene	0.021	0.00025
Xylenes	0.0072	0.000086

a Annual emissions assume 1 day to frac each well. Frac occurs 24 hours/day.

Pollutant	Road Travel from Completion [a] Single Well Emissions lb/hour	tons/year
NO_X	3.96	0.33
CO	2.65	0.22
VOC	0.21	0.017
SO_2	0.0041	0.00034
PM_{10}	8.14	0.55
$PM_{2.5}$	1.24	0.090

a Emissions include fugitive dust from vehicle traffic during completion and tailpipe emissions from trucks along the entire round trip mileage. Completion occurs over 7 days per well.

Interim Reclamation Emissions

Pollutant	Road Travel from Interim Rec [a] Single Pad Emissions lb/hour	tons/year
NO_X	0.30	0.0072
CO	0.19	0.0044
VOC	0.015	0.00036
SO_2	0.00030	0.0000072
PM_{10}	1.17	0.023
$PM_{2.5}$	0.17	0.0034

a Emissions include fugitive dust from vehicle traffic during interim reclamation and tailpipe emissions from trucks along the entire round trip mileage. Interim reclamation emissions only occur for 12 hours per day

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Operations Vehicle Emissions

Pollutant	Road Travel due to Operations [a]	
	Full field emissions	
	lb/hour	tons/year
NO_X	37.46	68.36
CO	8.92	16.28
VOC	1.16	2.12
SO_2	0.028	0.051
PM_{10}	90.26	133.78
$PM_{2.5}$	13.79	21.76

a Emissions include fugitive dust from vehicle traffic during operations and tailpipe emissions from trucks along the entire round trip mileage. Operation traffic only occur for 10 hours per day. Emissions are for all trucks in the Project Area at any given time and not from a single emission point.

Operations Heaters

Pollutant	EcoNode Heaters [a]	
	Per EcoNode	
	lb/hour	tons/year
NO_X	1.64	7.17
CO	1.37	6.02
VOC	0.090	0.39
SO_2	0.010	0.043
PM_{10}	0.12	0.54
$PM_{2.5}$	0.12	0.54
Acetaldehyde	----	----
Acrolein	----	----
Formaldehyde	0.0012	0.0054
Methanol	----	----
n-Hexane	0.029	0.13
Benzene	0.000034	0.00015
Ethylbenzene	----	----
Toluene	0.000056	0.00024
Xylenes	----	----

a Total field wide heater emissions divided by 4 EcoNodes, which equates to heater emissions from 22.25 wells per EcoNode.

Operations Engines

Pollutant	EcoNode Engines [a]	
	Per EcoNode	
	lb/hour	tons/year
NO_X	29.96	131.25
CO	59.93	262.49
VOC	20.98	91.87
SO_2	0.066	0.29
PM_{10}	1.20	5.25
$PM_{2.5}$	1.20	5.25
Acetaldehyde	0.44	1.92
Acrolein	0.27	1.20
Formaldehyde	2.79	12.21
Methanol	0.14	0.62
n-Hexane	0.057	0.25
Benzene	0.030	0.13
Ethylbenzene	0.0021	0.0094
Toluene	0.023	0.10
Xylenes	0.0103	0.045

a Emissions assume 9 - 1380 hp compression engines per EcoNode, 6 - 150 hp VRU engines per EcoNode, and 1 - 272 hp generator engine per EcoNode

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Operations Flares

Pollutant	EcoNode Flares [a]	
	Per EcoNode	
	lb/hour	tons/year
NO_X	0.40	1.77
CO	2.19	9.61
VOC	11.00	48.17
SO_2	0.0068	0.030
PM_{10}	0.087	0.38
$PM_{2.5}$	0.087	0.38
Acetaldehyde	----	----
Acrolein	----	----
Formaldehyde	0.00085	0.0037
Methanol	----	----
n-Hexane	0.56	2.47
Benzene	0.10	0.42
Ethylbenzene	----	----
Toluene	0.000039	0.00017
Xylenes	----	----

a Emissions based on an average of 2963.8 scf/hr of vent gas to the flare at each EcoNode. VOC, benzene, and n-Hexane emissions include the portion of the storage tank gas not combusted (5%).

Operation Fugitive Emissions

Pollutant	EcoNode Fugitives [a]	
	Per EcoNode	
	lb/hour	tons/year
NO_X	----	----
CO	----	----
VOC	----	1.67
SO_2	----	----
PM_{10}	----	----
$PM_{2.5}$	----	----
Acetaldehyde	----	----
Acrolein	----	----
Formaldehyde	----	----
Methanol	----	----
n-Hexane	----	0.01
Benzene	----	0.003
Ethylbenzene	----	0.000079
Toluene	----	0.00071
Xylenes	----	0.00015

a Emissions include fugitive component leaks, truck loading, and pneumatics

East Pony 205/206 Drilling and Frac Schedule

Drill Rig #	Pad on Figure	Number of Wells During Period	Total Drill Rig Days on Pad	Scheduled Pad Spud Day of Project	Scheduled Pad Rig Release Day of Project	Total Frac Days on Pad	Scheduled Pad Frac Day of Project	Scheduled Pad Frac Release Day of Project
1	Magpul Federal LC21-685	5	41	1	42	7	87	94
2	Magpul Federal LC21-685	7	59	207	266	16	359	375
4	Magpul Federal LC21-685	4	31	325	356	8	431	439
2	Dukes Federal LC10-750	5	38	1	39	10	91	101
3	Dukes Federal LC10-750	5	73	207	280	20	371	391
3	Kramer Federal LC-22-725	2	17	1	18	4	101	105
4	Kramer Federal LC-22-725	4	59	207	266	16	375	391
4	Holliday Federal LC23-785	6	46	1	47	12	94	106
2	Holliday Federal LC23-785	4	59	252	311	16	391	407
2	Ringo Federal LC23-725	4	31	39	70	8	106	114
3	Ringo Federal LC23-725	3	45	280	325	12	407	419
3	Earp Federal LC23-745	5	38	18	56	10	105	115
4	Earp Federal LC23-745	4	59	266	325	16	407	423
1	Browning Federal LC24-790	4	31	42	73	8	114	122
4	Beretta Federal LC24-770	4	31	47	78	8	115	123
3	Remington Federal LC24-750	4	31	56	87	8	122	130
2	Winchester Federal LC24-730	4	31	70	101	8	123	131
1	Tombstone Federal LC23-765	4	59	266	325	16	391	407
1	Minutemen Federal LC21-625	3	24	325	349	6	419	425
2	Freedom Federal LC21-645	4	31	311	342	8	423	431
3	Constitution Federal LC21-665	4	31	325	356	8	425	433

Note: The above drilling and completion schedule is based on initial forecasted project data to be used for temporal and spatial modeling purposes only.

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Well Pad Construction Emissions (Dozer and Backhoe Fugitive Dust)

Hours of Construction	4	days per well pad
	12	hours per day
	48	hours per well pad
Annual amount of well pads	14	pads/year
Hours of Construction	1	days per well pad
	12	hours per day
	12	hours per well pad
Annual amount of well pads	1	pads/year
Watering Control Efficiency	50	%
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)$^{1.2}$ * (soil moisture content %)$^{-1.3}$* Control Efficiency
Emissions (PM_{15} lbs/hr) = 1.0 * (soil silt content %)$^{1.5}$ * (soil moisture content %)$^{-1.4}$ * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment
Emissions = 0.50 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	tons/well pad	tons/yr [b]	lbs/hr	tons/well pad	tons/yr [b]	tons/yr [b]
TSP	1.97	0.047	0.66	1.97	0.047	0.66	1.32
PM_{15}	0.50	0.0120	0.169	0.50	0.0120	0.169	0.34
PM_{10}	0.38	0.0090	0.126	0.38	0.0090	0.126	0.25
$PM_{2.5}$	0.21	0.0050	0.070	0.21	0.0050	0.070	0.139

Expanded Pads

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	tons/well pad	tons/yr [b]	lbs/hr	tons/well pad	tons/yr [b]	tons/yr [b]
TSP	1.97	0.012	0.012	1.97	0.012	0.012	0.024
PM_{15}	0.50	0.0030	0.0030	0.50	0.0030	0.0030	0.0060
PM_{10}	0.38	0.0023	0.0023	0.38	0.0023	0.0023	0.0045
$PM_{2.5}$	0.21	0.0012	0.0012	0.21	0.0012	0.0012	0.0025

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to dozer emissions.
b Assumes maximum development scenario

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Well Pad Construction Emissions (Grader Fugitive Dust)

Assumptions:

Hours of Construction	2	day grading per well pad
	12	hours/day
	24	hours per well pad
Number of well pads	14	well pads/year
Distance graded per pad	4.95	miles
Number of existing well pads	1	well pads/year
Distance graded per pad	0.75	miles
Watering Control Efficiency	50	%
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = 0.040 * (Mean Vehicle Speed)$^{2.5}$ * Distance Graded * Control Efficiency
Emissions (PM_{15} lbs) = 0.051 * (Mean Vehicle Speed)$^{2.0}$ * Distance Graded * Control Efficiency

	New Well Pad Grader Emissions		Expanded Well Pad Grader Emissions		Total Emissions
	lbs/hr-pad	tons/well pad	lbs/hr-pad	tons/well pad	tons/year[a]
TSP	0.55	0.0066	0.084	0.0010	0.094
PM_{15}	0.27	0.0032	0.040	0.00048	0.045
PM_{10}	0.16	0.0019	0.024	0.00029	0.027
$PM_{2.5}$	0.017	0.00021	0.0026	0.000031	0.0029

a Assumes maximum development scenario

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Water Well Pad Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	6	days per well pad
	12	hours per day
	72	hours per well pad
Annual amount of well pads	1	pads/year
Watering Control Efficiency	50	%
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)$^{1.2}$ * (soil moisture content %)$^{-1.3}$* Control Efficiency

Emissions (PM_{15} lbs/hr) = 1.0 * (soil silt content %)$^{1.5}$ * (soil moisture content %)$^{-1.4}$ * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			**Backhoe Emissions [a]**			**Total**
	lbs/hr	**tons/well pad**	**tons/yr [b]**	**lbs/hr**	**tons/well pad**	**tons/yr [b]**	**tons/yr [b]**
TSP	1.97	0.071	0.071	1.97	0.071	0.071	0.14
PM_{15}	0.50	0.018	0.018	0.50	0.018	0.018	0.036
PM_{10}	0.38	0.014	0.014	0.38	0.014	0.014	0.027
$PM_{2.5}$	0.21	0.0074	0.0074	0.21	0.0074	0.0074	0.015

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to dozer emissions.

b Assumes maximum development scenario

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EcoNode Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	4	days per EcoNode
	12	hours per day
	48	hours per EcoNode
Annual amount of EcoNodes	4	EcoNodes/year
Watering Control Efficiency	50	%
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)$^{1.2}$ * (soil moisture content %)$^{-1.3}$* Control Efficiency
Emissions (PM_{15} lbs/hr) = 1.0 * (soil silt content %)$^{1.5}$ * (soil moisture content %)$^{-1.4}$ * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment
Emissions = 0.50 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	**tons/EcoNode**	**tons/yr [b]**	**lbs/hr**	**tons/EcoNode**	**tons/yr [b]**	**tons/yr [b]**
TSP	1.97	0.047	0.19	1.97	0.047	0.19	0.38
PM_{15}	0.50	0.012	0.048	0.50	0.012	0.048	0.10
PM_{10}	0.38	0.0090	0.036	0.38	0.0090	0.036	0.072
$PM_{2.5}$	0.21	0.0050	0.020	0.21	0.0050	0.020	0.040

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to dozer emissions.
b Assumes maximum development scenario

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EcoNode Construction Emissions (Grader Fugitive Dust)

Assumptions:

Hours of Construction	3	day grading per EcoNode
	12	hours/day
	36	hours per EcoNode
Number of EcoNodes	4	EcoNodes/year
Distance graded per EcoNode	11.5	miles
Watering Control Efficiency	50	%
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = 0.040 * (Mean Vehicle Speed)$^{2.5}$ * Distance Graded * Control Efficiency
Emissions (PM_{15} lbs) = 0.051 * (Mean Vehicle Speed)$^{2.0}$ * Distance Graded * Control Efficiency

	Grader Emissions		Total Emissions
	lbs/hr	**tons/EcoNode**	**tons/year[a]**
TSP	0.86	0.0154	0.062
PM_{15}	0.41	0.0074	0.030
PM_{10}	0.246	0.00443	0.018
$PM_{2.5}$	0.0266	0.000479	0.0019

a Assumes maximum development scenario

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Road Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	2	days per mile
	12	hours per day
	24	hours per mile
	2.2	miles of new road
	1.9	miles of existing road upgrades
Watering Control Efficiency	50	%
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98 & 7/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)$^{1.2}$ * (soil moisture content %)$^{-1.3}$* Control Efficiency
Emissions (PM_{15} lbs/hr) = 1.0 * (soil silt content %)$^{1.5}$ * (soil moisture content %)$^{-1.4}$ * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment
Emissions = 0.50 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]		Backhoe Emissions [a]		Total
	lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
TSP	1.97	0.097	1.97	0.097	0.19
PM_{15}	0.50	0.025	0.50	0.025	0.049
PM_{10}	0.38	0.019	0.38	0.019	0.037
$PM_{2.5}$	0.21	0.010	0.21	0.010	0.020

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to dozer emissions.

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Road Construction Emissions (Grader Fugitive Dust)

Assumptions:

Hours of Construction	24	hours per mile
Road grading miles	12	miles
Watering Control Efficiency	50	%
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = $0.040 \times (\text{Mean Vehicle Speed})^{2.5} \times \text{Distance Graded} \times \text{Control Efficiency}$

Emissions (PM_{15} lbs) = $0.051 \times (\text{Mean Vehicle Speed})^{2.0} \times \text{Distance Graded} \times \text{Control Efficiency}$

	Grader Construction Emissions - Roads	
	lbs/hr	**tons/year[a]**
TSP	0.11	0.017
PM_{15}	0.054	0.0079
PM_{10}	0.032	0.0047
$PM_{2.5}$	0.0035	0.00051

a Assumes maximum development scenario

Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Pipeline Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	4	days per mile
	12	hours per day
	48	hours per mile
	4.8	miles of oil and gas pipeline
	1.1	miles of buried water pipeline
Watering Control Efficiency	50	%
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98 & 7/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)$^{1.2}$ * (soil moisture content %)$^{-1.3}$* Control Efficiency
Emissions (PM_{15} lbs/hr) = 1.0 * (soil silt content %)$^{1.5}$ * (soil moisture content %)$^{-1.4}$ * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment
Emissions = 0.50 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]		Backhoe Emissions [a]		Total
	lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
TSP	1.97	0.28	1.97	0.28	0.56
PM_{15}	0.50	0.071	0.50	0.071	0.14
PM_{10}	0.38	0.053	0.38	0.053	0.11
$PM_{2.5}$	0.21	0.029	0.21	0.029	0.059

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to dozer emissions.

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Pipeline Construction Emissions (Grader Fugitive Dust)

Assumptions:

Hours of Construction	48	hours per mile
Pipeline grading miles	61	miles
Watering Control Efficiency	50	%
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = 0.040 * (Mean Vehicle Speed)$^{2.5}$ * Distance Graded * Control Efficiency
Emissions (PM_{15} lbs) = 0.051 * (Mean Vehicle Speed)$^{2.0}$ * Distance Graded * Control Efficiency

	Grader Construction Emissions - Pipeline	
	lbs/hr	**tons/year[a]**
TSP	0.056	0.081
PM_{15}	0.027	0.039
PM_{10}	0.016	0.023
$PM_{2.5}$	0.0017	0.0025

a Assumes maximum development scenario

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Date: 2/27/2015

Development Traffic Fugitive Dust Emissions

Public Road Unpaved
AP-42 Chapter 13.2.2, November 2006

$E(PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365$ Annual

$E(PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365$ Annual

$E(PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily

$E(PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily

Silt Content (s)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surface Mining Plant Roads
Moisture Content (M)	7.9	%
Average Speed (S)	20.0	mph
Round Trip Miles	23	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

Control efficiency for water or chemical suppression on unpaved roads 50 %

Industrial Unpaved Calculation
AP-42 Chapter 13.2.2, November 2006

$E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365$ Annual

$E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365$ Annual

$E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$ Daily

$E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$ Daily

Silt Content (S)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surface Mining Plant Roads
Round Trip Miles	2	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

Control efficiency for water or chemical suppression on unpaved roads 50 %

W = average weight in tons of vehicles traveling the road

Paved Calculation AP-42, Chapter 13.2.1
January 2011

$E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$ Annual

$E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$ Annual

$E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$ Daily

$E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$ Daily

Silt Loading (sL)	0.6	AP-42 Table 13.2.1-3 baseline low volume roads
Round Trip Miles	110	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

W = average weight in tons of vehicles traveling the road

Construction Emissions - Well Pads/Roads

Hours per day	12	hour/day
Days per pad	8	day/well pad
Number of pads per year	15	well pads/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Pad
Haul Trucks	35,000	4
Light Trucks	4,000	2
Mean Vehicle Weight	24,667	---
Total Round Trips	---	6

	Emission Factor		**Public Unpaved Road Emisions**		
	Daily	**Annual**			**Total pads**
	lb/VMT	**lb/VMT**	**lb/hr**	**ton/year-pad**	**ton/year**
PM_{10}	0.18	0.14	2.09	0.077	1.16
$PM_{2.5}$	0.018	0.014	0.21	0.0077	0.12

	Emission Factor		**Industrial Unpaved Road Emisions**		
	Daily	**Annual**			**Total pads**
	lb/VMT	**lb/VMT**	**lb/hr**	**ton/year-pad**	**ton/year**
PM_{10}	0.66	0.50	0.66	0.024	0.36
$PM_{2.5}$	0.066	0.050	0.066	0.0024	0.036

	Emission Factor		**Paved Road Emisions**		
	Daily	**Annual**			**Total pads**
	lb/VMT	**lb/VMT**	**lb/hr**	**ton/year-pad**	**ton/year**
PM_{10}	0.018	0.017	0.99	0.045	0.67
$PM_{2.5}$	0.0044	0.0041	0.24	0.011	0.16

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Construction Emissions - Water Well Pads

Hours per day	12	hour/day
Days per pad	6	day/well pad
Number of pads per year	1	well pads/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day Day per Pad
Haul Trucks	35,000	4
Light Trucks	4,000	2
Mean Vehicle Weight	24,667	---
Total Round Trips	---	6

	Emission Factor		Public Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.18	0.14	2.09	0.058	0.058
$PM_{2.5}$	0.018	0.014	0.21	0.0058	0.0058

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.66	0.50	0.66	0.018	0.018
$PM_{2.5}$	0.066	0.050	0.066	0.0018	0.0018

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.018	0.017	0.99	0.033	0.033
$PM_{2.5}$	0.0044	0.0041	0.24	0.0082	0.008

Construction Emissions - EcoNodes

Hours per day	12	hour/day
Days per pad	7	day/well pad
Number of pads per year	4	well pads/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Pad
Haul Trucks	35,000	1
Water Trucks and other	22,000	7
Light Trucks	4,000	11
Mean Vehicle Weight	12,263	---
Total Round Trips	---	19

	Emission Factor		Public Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.18	0.14	6.63	0.21	0.85
$PM_{2.5}$	0.018	0.014	0.66	0.021	0.085

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.48	0.37	1.52	0.049	0.20
$PM_{2.5}$	0.048	0.037	0.15	0.0049	0.020

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.009	0.008	1.53	0.061	0.24
$PM_{2.5}$	0.0022	0.0020	0.38	0.015	0.059

Total Annual Traffic Fugitive Dust Emissions (tons/year)

	Unpaved Total	Paved Total	Total
	tons/year	tons/year	tons/year
PM_{10}	2.65	0.94	3.59
$PM_{2.5}$	0.26	0.23	0.50

Notes:
a Weight of haul trucks, water trucks, and other heavy trucks calculated as average of empty weight (10,000 lbs) and full weight for the round trip (full weight is 54,000 lbs - 80,000 lbs depending on truck type).

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Construction Tailpipe Emissions

Average round trip distance	133	miles	Water well pads per year	1	water well pads/year
Hours per day for construction	12	hours/day	Number of heavy diesel truck trips	24	trips/water well pad
Well pads per year	15	well pads/year	Number of light truck trips	12	trips/water well pad
Number of heavy diesel truck trips	32	trips/well pad	EcoNodes per year	4	EcoNodes/year
Number of light truck trips	16	trips/well pad	Number of heavy diesel truck trips	47	trips/EcoNodes
			Number of light truck trips	74	trips/EcoNodes

Construction Vehicles	Heavy Haul Trucks - Well Pads			Heavy Duty Pickups - Well Pads			Total	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions [c]
	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/hr-pad)	(tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	2.47	0.11	4.39E-03	0.11	0.0047	2.58	1.66
CO	1.15E-02	0.57	0.024	2.18E-02	0.54	0.023	1.11	0.72
VOC	1.52E-03	0.075	0.0032	1.17E-03	0.029	0.0012	0.10	0.067
SO_2	3.65E-05	0.0018	0.000078	1.75E-05	0.00043	0.000019	0.0022	0.0014
PM_{10}	2.72E-03	0.13	0.0058	8.54E-05	0.0021	0.000091	0.14	0.088
$PM_{2.5}$	2.64E-03	0.13	0.0056	7.87E-05	0.0019	0.000084	0.13	0.086
Greenhouse Gases								
CO_2	5.38E+00	266.60	11.47	1.01E+00	24.91	1.07	291.51	188.15
CH_4	5.52E-05	0.0027	0.00012	6.84E-05	0.0017	0.000073	0.0044	0.0029
N_2O	6.04E-06	0.00030	0.000013	3.35E-05	0.00083	0.000036	0.0011	0.00073
CO_2e [d]	---	266.75	11.48	---	25.20	1.08	291.96	188.44

Construction Vehicles	Heavy Haul Trucks - Water Well Pads			Heavy Duty Pickups - Water Well Pads			Total	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions [c]
	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/hr-pad)	(tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	2.21	0.080	4.39E-03	0.10	0.0035	2.31	0.083
CO	1.15E-02	0.51	0.018	2.18E-02	0.49	0.017	1.00	0.036
VOC	1.52E-03	0.068	0.0024	1.17E-03	0.026	0.00094	0.094	0.0034
SO_2	3.65E-05	0.0016	0.000058	1.75E-05	0.00039	0.000014	0.0020	0.000072
PM_{10}	2.72E-03	0.12	0.0044	8.54E-05	0.0019	0.000068	0.12	0.0044
$PM_{2.5}$	2.64E-03	0.12	0.0042	7.87E-05	0.0017	0.000063	0.12	0.0043
Greenhouse Gases								
CO_2	5.38E+00	238.98	8.60	1.01E+00	22.33	0.80	261.32	9.41
CH_4	5.52E-05	0.0025	0.000088	6.84E-05	0.0015	0.000055	0.0040	0.00014
N_2O	6.04E-06	0.00027	0.000010	3.35E-05	0.00074	0.000027	0.0010	0.00004
CO_2e [d]	---	239.13	8.61	---	22.59	0.81	261.72	141.33

Construction Vehicles	Heavy Haul Trucks - EcoNodes			Heavy Duty Pickups - EcoNodes			Total	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions [c]
	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/mile)	(lb/hr-pad)	(tons/yr/pad)	(lb/hr-pad)	(tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	3.71	0.16	4.39E-03	0.52	0.022	4.23	0.71
CO	1.15E-02	0.86	0.036	2.18E-02	2.56	0.11	3.42	0.57
VOC	1.52E-03	0.11	0.0048	1.17E-03	0.14	0.0058	0.25	0.042
SO_2	3.65E-05	0.0027	0.00011	1.75E-05	0.0021	0.00009	0.0048	0.00080
PM_{10}	2.72E-03	0.20	0.0085	8.54E-05	0.010	0.00042	0.21	0.036
$PM_{2.5}$	2.64E-03	0.20	0.0083	7.87E-05	0.009	0.00039	0.21	0.035
Greenhouse Gases								
CO_2	5.38E+00	401.15	16.85	1.01E+00	118.04	4.96	519.19	87.22
CH_4	5.52E-05	0.0041	0.00017	6.84E-05	0.0080	0.00034	0.012	0.0020
N_2O	6.04E-06	0.00045	0.000019	3.35E-05	0.0039	0.00017	0.0044	0.00074
CO_2e [d]	---	401.39	16.86	---	119.41	5.02	520.80	328.10

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
c Assumes maximum development scenario
d Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Construction Heavy Equipment Tailpipe Emissions - Well Pads

Assumptions:

Development Rate	15	new pads per year
Backhoe Hours	48	hours per pad
Backhoe HP	87	(Average HP - Backhoe)
Load Factor	0.21	(Default LF from NONROAD model for Tractors/Loaders/Backhoes)
Dozer Hours	48	hours per pad
Dozer HP	135	(Average HP - Dozers)
Load Factor	0.59	(Default LF from NONROAD model for Crawler Tractor/Dozers)
Motor Grader Hours	24	hours per pad
Grader HP	230	(Average HP - Graders)
Load Factor	0.59	(Default LF from NONROAD model for Graders)

Heavy Const. Vehicles	Backhoe			Dozer			Grader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)
Criteria Pollutants & VOC									
NOx	6.9	0.28	0.0067	8.38	1.47	0.035	8.38	2.51	0.030
CO	3.49	0.14	0.0034	2.7	0.47	0.0114	2.70	0.81	0.010
VOC [b]	0.99	0.040	0.00096	0.68	0.12	0.0029	0.68	0.20	0.0024
PM_{10}	0.722	0.029	0.00070	0.402	0.071	0.00169	0.402	0.12	0.0014
$PM_{2.5}$	0.722	0.029	0.00070	0.402	0.071	0.00169	0.402	0.12	0.0014
Greenhouse Gases									
CO_2 [c]	188.2	7.58	0.182	188.2	33.05	0.79	188.2	56.30	0.68
CO_2e [e]	---	7.58	0.182	---	33.05	0.79	---	56.30	0.68

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions [d] (tons/yr)
Criteria Pollutants & VOC		
NOx	4.26	1.08
CO	1.42	0.37
VOC	0.36	0.094
PM_{10}	0.22	0.058
$PM_{2.5}$	0.22	0.058
Greenhouse Gases		
CO_2	96.92	24.76
CO_2e [e]	96.92	24.76

a From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010.
b Emission Factor represents total Hydrocarbon Emissions
c Converted from emission factor for Distillate Fuel Oil #2 (diesel) as listed in Table C-1 to Subpart C of Part 98 - Default Emission Factors and High Heat Values for Various Types of Fuel.
Listed Factor: 73.96 kg CO_2/mmBtu
393 hp-hr = mmBtu
188.2 g CO_2/hp-hr
d Assumes maximum development scenario
e Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Construction Heavy Equipment Tailpipe Emissions - Water Well Pads

Assumptions:

Development Rate	1	new pads per year
Backhoe Hours	72	hours per pad
Backhoe HP	87	(Average HP - Backhoe)
Load Factor	0.21	(Default LF from NONROAD model for Tractors/Loaders/Backhoes)
Dozer Hours	72	hours per pad
Dozer HP	135	(Average HP - Dozers)
Load Factor	0.59	(Default LF from NONROAD model for Crawler Tractor/Dozers)

Heavy Const. Vehicles	Backhoe			Dozer			Total	
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	Emissions (lb/hr)	Emissions [d] (tons/yr)
Criteria Pollutants & VOC								
NOx	6.9	0.28	0.010	8.38	1.47	0.053	1.75	0.06
CO	3.49	0.14	0.0051	2.7	0.47	0.017	0.61	0.022
VOC [b]	0.99	0.040	0.0014	0.68	0.12	0.0043	0.16	0.0057
PM_{10}	0.722	0.029	0.0010	0.402	0.071	0.0025	0.10	0.0036
$PM_{2.5}$	0.722	0.029	0.0010	0.402	0.071	0.0025	0.10	0.0036
Greenhouse Gases								
CO_2 [c]	188.2	7.58	0.27	188.2	33.05	1.19	40.63	1.46
CO_2e [e]	---	7.58	0.27	---	33.05	1.19	40.63	1.46

a From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010.
b Emission Factor represents total Hydrocarbon Emissions
c Converted from emission factor for Distillate Fuel Oil #2 (diesel) as listed in Table C-1 to Subpart C of Part 98 - Default Emission Factors and High Heat Values for Various Types of Fuel.
Listed Factor: 73.96 kg CO_2/mmBtu
393 hp-hr = mmBtu
188.2 g CO_2/hp-hr
d Assumes maximum development scenario
e Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Construction Heavy Equipment Tailpipe Emissions - EcoNodes

Assumptions:

Development Rate	4	new pads per year
Backhoe Hours	48	hours per pad
Backhoe HP	87	(Average HP - Backhoe)
Load Factor	0.21	(Default LF from NONROAD model for Tractors/Loaders/Backhoes)
Dozer Hours	48	hours per pad
Dozer HP	135	(Average HP - Dozers)
Load Factor	0.59	(Default LF from NONROAD model for Crawler Tractor/Dozers)
Motor Grader Hours	36	hours per pad
Grader HP	230	(Average HP - Graders)
Load Factor	0.59	(Default LF from NONROAD model for Graders)

Heavy Const. Vehicles	Backhoe			Dozer			Grader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)
Criteria Pollutants & VOC									
NOx	6.9	0.28	0.0067	8.38	1.47	0.035	8.38	2.51	0.045
CO	3.49	0.14	0.0034	2.7	0.47	0.011	2.70	0.81	0.015
VOC [b]	0.99	0.040	0.0010	0.68	0.12	0.0029	0.68	0.20	0.0037
PM_{10}	0.722	0.029	0.00070	0.402	0.071	0.0017	0.402	0.12	0.0022
$PM_{2.5}$	0.722	0.029	0.00070	0.402	0.071	0.0017	0.402	0.12	0.0022
Greenhouse Gases									
CO_2 [c]	188.2	7.58	0.18	188.2	33.05	0.79	188.2	56.30	1.01
CO_2e [e]	---	7.58	0.18	---	33.05	0.79	---	56.30	1.01

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions [d] (tons/yr)
Criteria Pollutants & VOC		
NOx	4.26	0.35
CO	1.42	0.12
VOC	0.36	0.030
PM_{10}	0.22	0.018
$PM_{2.5}$	0.22	0.018
Greenhouse Gases		
CO_2	96.92	7.95
CO_2e [e]	96.92	7.95

a From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010.
b Emission Factor represents total Hydrocarbon Emissions
c Converted from emission factor for Distillate Fuel Oil #2 (diesel) as listed in Table C-1 to Subpart C of Part 98 - Default Emission Factors and High Heat Values for Various Types of Fuel.

Listed Factor: 73.96 kg CO_2/mmBtu
393 hp-hr = mmBtu
188.2 g CO_2/hp-hr

d Assumes maximum development scenario
e Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

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Wind Erosion Fugitive Dust Emissions

Threshold Friction Velocity (U_t) 1.18 m/s - average of AP-42 Table 13.2.5-2 Overburden and roadbed material

Initial Disturbance Area 84 acres initial disturbance in development at one time*
339,577 square meters initial disturbance in development at one time*
*assume 4 pads with associated roads and pipelines and 1 EcoNode

4 months until interim reclamation for initial disturbance

Operation and Maintenance Disturbance Area 141 acres total reclaimed disturbance
571,011 square meters total reclaimed disturbance

Meteorological Data Denver International Airport 1996-2008 Maximum 2 minute wind (WRCC website)
Wind Speed (U_{10}^+) 26 meters/sec reported as fastest 2-minute wind speed

Number soil of disturbances 1.42 wind events per month

Watering Control Efficiency 50 % - during construction only

Equations (AP-42 13.2.5.2 Industrial Wind Erosion)

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, $P = 0$ for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton

Particle Size Multiplier (k)		
30 µm	<10 µm	<2.5 µm
1.0	0.5	0.075

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	U_t* Threshold Velocity[a] m/s	Erosion Potential g/m^2-period
26	1.38	1.18	7.47

Particulate Species	Construction Emissions Per Development Group (tons/year)	Construction Emissions Total Initial Development (tons/year)	Operation and Maintenance[a] Per Year (tons/year)	Total (tons/year)
TSP	7.92	27.71	7.99	35.70
PM_{10}	3.96	13.86	3.99	17.85
$PM_{2.5}$	0.59	2.08	0.60	2.68

a Operation and maintenance wind erosion assumes 1/10 of the long term acreage is disturbed at one time

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Drilling Tailpipe Emissions

Number of wells drilled	89	wells	Number of water wells drilled	1	wells
Average Round Trip Distance	133.3	miles	Average Round Trip Distance	133.3	miles
Hours of Operation	240	hours/well	Hours of Operation	360	hours/well
Number of Heavy Diesel Truck Trips	70	trips/well	Number of Heavy Diesel Truck Trips	105	trips/well
Number of Pickup Trips	140	trips/well	Number of Pickup Trips	210	trips/well

Drilling Vehicles	Heavy Haul Trucks - Oil & Gas Wells			Heavy Duty Pickups - Oil & Gas Wells			Total	
	E. Factor [a] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	Emissions (lb/hr-well)	Emissions [c] (tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	1.94	0.23	4.39E-03	0.34	0.041	2.28	24.31
CO	1.15E-02	0.45	0.054	2.18E-02	1.70	0.20	2.14	22.90
VOC [e]	1.52E-03	0.059	0.0071	1.17E-03	0.091	0.011	0.150	1.60
SO_2	3.65E-05	0.0014	0.00017	1.75E-05	0.0014	0.00016	0.0028	0.030
PM_{10}	2.72E-03	0.11	0.013	8.54E-05	0.0066	0.00080	0.11	1.20
$PM_{2.5}$	2.64E-03	0.10	0.012	7.87E-05	0.0061	0.00073	0.11	1.16
Greenhouse Gases								
CO_2	5.38E+00	209.11	25.09	1.01E+00	78.16	9.38	287.27	3068.05
CH_4	5.52E-05	0.0021	0.00026	6.84E-05	0.0053	0.00064	0.0075	0.080
N_2O	6.04E-06	0.00023	0.000028	3.35E-05	0.0026	0.00031	0.0028	0.030
CO_2e [d]	---	209.24	25.11	---	79.07	9.49	288.30	3079.07

Drilling Vehicles	Heavy Haul Trucks - Water Wells			Heavy Duty Pickups - Water Wells			Total	
	E. Factor [a] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	Emissions (lb/hr-well)	Emissions [c] (tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	1.94	0.35	4.39E-03	0.34	0.061	2.28	0.41
CO	1.15E-02	0.45	0.080	2.18E-02	1.70	0.31	2.14	0.39
VOC [e]	1.52E-03	0.059	0.011	1.17E-03	0.091	0.016	0.15	0.03
SO_2	3.65E-05	0.0014	0.00026	1.75E-05	0.0014	0.00025	0.0028	0.0005
PM_{10}	2.72E-03	0.11	0.019	8.54E-05	0.0066	0.0012	0.11	0.020
$PM_{2.5}$	2.64E-03	0.10	0.018	7.87E-05	0.0061	0.0011	0.11	0.020
Greenhouse Gases								
CO_2	5.38E+00	209.11	37.64	1.01E+00	78.16	14.07	287.27	51.71
CH_4	5.52E-05	0.0021	0.00039	6.84E-05	0.0053	0.0010	0.0075	0.0013
N_2O	6.04E-06	0.00023	0.000042	3.35E-05	0.0026	0.00047	0.0028	0.0005
CO_2e [d]	---	209.24	37.66	---	79.07	14.23	288.30	4618.61

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
c Assumes maximum development scenario
d Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA

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Completion Tailpipe Emissions

Assumptions:

Number of wells	89	wells
Average Round Trip Distance	133.3	miles
Hours of Operation	168	hours per well
Number of Heavy Diesel Truck Trips	91	trips/well
Number of Pickup Trips	105	trips/well

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total	
	E. Factor [a] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr-well)	Emissions (tons/yr/well)	Emissions (lb/hr-well)	Emissions [c] (tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	3.59	0.30	4.39E-03	0.37	0.031	3.96	29.60
CO	1.15E-02	0.83	0.070	2.18E-02	1.82	0.15	2.65	19.80
VOC [c]	1.52E-03	0.11	0.0092	1.17E-03	0.097	0.0082	0.21	1.55
SO_2	3.65E-05	0.0026	0.00022	1.75E-05	0.0015	0.00012	0.0041	0.031
PM_{10}	2.72E-03	0.20	0.017	8.54E-05	0.0071	0.00060	0.20	1.52
$PM_{2.5}$	2.64E-03	0.19	0.016	7.87E-05	0.0066	0.00055	0.20	1.47
Greenhouse Gases								
CO_2	5.38E+00	388.35	32.62	1.01E+00	83.74	7.03	472.09	3529.36
CH_4	5.52E-05	0.0040	0.00033	6.84E-05	0.0057	0.00048	0.0097	0.072
N_2O	6.04E-06	0.00044	0.000037	3.35E-05	0.0028	0.00023	0.0032	0.024
CO_2e [d]	---	388.58	32.64	---	84.71	7.12	473.29	3538.4

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
c Assumes maximum development scenario
d Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA
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Interim Reclamation Tailpipe Emissions

Assumptions:

Number of new well pads	16	(includes water well pad)
Average Round Trip Distance	133.3	miles
Hours of Operation	48	hours per site
Number of Heavy Diesel Truck Trips	2	trips/well pad
Number of Pickup Trips	2	trips/well pad

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total	
	E. Factor [a] (lb/mile)	Emissions (lb/hr-pad)	Emissions (tons/yr/pad)	E. Factor [b] (lb/mile)	Emissions (lb/hr-pad)	Emissions (tons/yr/pad)	Emissions (lb/hr-pad)	Emissions [c] (tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	0.28	0.0066	4.39E-03	0.024	0.00058	0.30	0.12
CO	1.15E-02	0.064	0.0015	2.18E-02	0.12	0.0029	0.19	0.071
VOC [e]	1.52E-03	0.0085	0.00020	1.17E-03	0.0065	0.00016	0.015	0.0057
SO_2	3.65E-05	0.00020	0.0000049	1.75E-05	0.00010	0.0000023	0.00030	0.00012
PM_{10}	2.72E-03	0.015	0.00036	8.54E-05	0.00047	0.000011	0.016	0.0060
$PM_{2.5}$	2.64E-03	0.015	0.00035	7.87E-05	0.00044	0.000010	0.015	0.0058
Greenhouse Gases								
CO_2	5.38E+00	29.87	0.72	1.01E+00	5.58	0.13	35.46	13.62
CH_4	5.52E-05	0.00031	0.0000074	6.84E-05	0.00038	0.0000091	0.00069	0.00026
N_2O	6.04E-06	0.000034	0.00000080	3.35E-05	0.00019	0.0000045	0.00022	0.00008
CO_2e [d]	---	29.89	0.72	---	5.65	0.136	35.54	13.65

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.
c Assumes maximum development scenario
d Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

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Development Traffic Fugitive Dust Emissions

Public Road Unpaved
AP-42 Chapter 13.2.2, November 2006

$E (PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365)$ Annual
$E (PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365)$ Annual
$E (PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily
$E (PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily

Silt Content (s)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surface Mining Plant Roads
Moisture Content (M)	7.9	%
Average Speed (S)	20.0	mph
Round Trip Miles	23	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

Control efficiency for water or chemical suppression on unpaved roads 50 %

Industrial Unpaved Calculation
AP-42 Chapter 13.2.2, November 2006

$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365)$ Annual
$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365)$ Annual
$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$ Daily
$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$ Daily

Silt Content (S)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surface Mining Plant Roads
Round Trip Miles	2	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

Control efficiency for water or chemical suppression on unpaved roads 50 %
W = average weight in tons of vehicles traveling the road

Paved Calculation AP-42, Chapter 13.2.1
January 2011

$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$ Annual
$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$ Annual
$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$ Daily
$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$ Daily

Silt Loading (sL)	0.6	AP-42 Table 13.2.1-3 baseline low volume roads
Round Trip Miles	110	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

W = average weight in tons of vehicles traveling the road

Drilling Traffic - Oil and Gas Wells

Hours per day	24	hour/day
Days per well	10	day/well
Number of wells per year	89	wells/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Well
Haul Trucks	35,000	7
Light Trucks	4,000	14
Mean Vehicle Weight	14,333	---
Total Round Trips	---	21

	Emission Factor		Public Unpaved Road Emissions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.18	0.14	3.67	0.34	30.04
$PM_{2.5}$	0.018	0.014	0.37	0.034	3.00

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.51	0.39	0.90	0.083	7.37
$PM_{2.5}$	0.05	0.039	0.090	0.0083	0.74

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.010	0.010	0.99	0.11	9.97
$PM_{2.5}$	0.0025	0.0024	0.24	0.028	2.45

Drilling Traffic - Water Wells

Hours per day	24	hour/day
Days per well	15	day/well
Number of wells per year	1	wells/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Well
Haul Trucks	35,000	7
Light Trucks	4,000	14
Mean Vehicle Weight	14,333	---
Total Round Trips	---	21

	Emission Factor		Public Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.18	0.14	3.67	0.51	0.51
$PM_{2.5}$	0.018	0.014	0.37	0.051	0.05

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.51	0.39	0.90	0.12	0.12
$PM_{2.5}$	0.05	0.039	0.090	0.012	0.012

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.010	0.010	0.99	0.17	0.17
$PM_{2.5}$	0.0025	0.0024	0.24	0.041	0.04

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Completion Traffic

Hours per day	24	hour/day
Days per well	7	day/well
Number of wells per year	89	wells/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Well
Haul Trucks	35,000	13
Light Trucks	4,000	15
Mean Vehicle Weight	18,393	---
Total Round Trips	---	28

	Emission Factor		Public Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.18	0.14	4.89	0.31	28.03
$PM_{2.5}$	0.018	0.014	0.49	0.031	2.80

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.57	0.44	1.34	0.086	7.69
$PM_{2.5}$	0.06	0.04	0.13	0.0086	0.77

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total wells
	lb/VMT	lb/VMT	lb/hr	ton/year-well	ton/year
PM_{10}	0.013	0.013	1.71	0.13	12.01
$PM_{2.5}$	0.0033	0.0031	0.42	0.033	2.95

Interim Reclamation Traffic

Hours per day	12	hour/day
Days per well pad	4	day/well pad
Number of wellpads per year	16	well pads/year

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Well
Haul Trucks	35,000	1
Light Trucks	4,000	1
Mean Vehicle Weight	19,500	---
Total Round Trips	---	2

	Emission Factor		Public Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.18	0.14	0.70	0.013	0.21
$PM_{2.5}$	0.018	0.014	0.070	0.0013	0.021

	Emission Factor		Industrial Unpaved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.59	0.45	0.20	0.0036	0.058
$PM_{2.5}$	0.06	0.05	0.020	0.00036	0.0058

	Emission Factor		Paved Road Emisions		
	Daily	Annual			Total pads
	lb/VMT	lb/VMT	lb/hr	ton/year-pad	ton/year
PM_{10}	0.014	0.013	0.26	0.0058	0.09
$PM_{2.5}$	0.0035	0.0033	0.063	0.0014	0.023

Total Annual Traffic Fugitive Dust Emissions (tons/year)

	Unpaved Total tons/year	Paved Total tons/year	Total tons/year
PM_{10}	74.02	22.24	96.27
$PM_{2.5}$	7.40	5.46	12.86

Notes:
a Weight of haul trucks, water trucks, and other heavy trucks calculated as average of empty weight (10,000 lbs) and full weight for the round trip (full weight is 54,000 lbs - 80,000 lbs depending on truck type).

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Drill Rig Engine Emissions

Assumptions:		
Drilling Hours of Operation	240	hours/well
Development Rate	89	wells/year
Drilling Hours of Operation	360	hours/water well
Development Rate	1	water wells/year
Drill Rig Engines	2,400	hp
Drill Rig Load Factor	0.5	

Drill Rig Emissions - LNG/NG

Species	Drill Rig E. Factor (lb/hp-hr)	Drill Rig Emissions (lb/hr-well)	Drill Rig Emissions (lb/hr-water well)	Drill Rig Emissions (tons/yr-well)	Drill Rig Emissions (tons/yr-water well)	Total Emissions [a] (tons/yr)
Criteria Pollutants & VOC						
NOx [b]	2.20E-03	2.65	2.65	0.32	0.48	28.73
CO [b]	4.41E-03	5.29	5.29	0.63	0.95	57.46
VOC [b]	1.54E-03	1.85	1.85	0.22	0.33	20.11
PM_{10} [c]	1.59E-04	0.19	0.19	0.023	0.034	2.07
$PM_{2.5}$ [c]	1.59E-04	0.19	0.19	0.023	0.034	2.07
SO_2 [c]	4.82E-06	0.0058	0.0058	0.00069	0.0010	0.063
Hazardous Air Pollutants [c]						
1,1,2,2-Tetrachloroethane	2.07E-07	0.00025	0.00025	0.000030	0.000045	0.0027
1,1,2-Trichloroethane	1.25E-07	0.00015	0.00015	0.000018	0.000027	0.0016
1.3-Butadiene	5.44E-06	0.0065	0.0065	0.00078	0.0012	0.071
1,3-Dichloropropene	1.04E-07	0.00012	0.00012	0.000015	0.000022	0.0014
Acetaldehyde	2.29E-05	0.027	0.027	0.0033	0.0049	0.30
Acrolein	2.16E-05	0.026	0.026	0.0031	0.0047	0.28
Benzene	1.30E-05	0.016	0.016	0.0019	0.0028	0.17
Carbon Tetrachloride	1.45E-07	0.00017	0.00017	0.000021	0.000031	0.0019
Chlorobenzene	1.06E-07	0.00013	0.00013	0.000015	0.000023	0.0014
Chloroform	1.12E-07	0.00013	0.00013	0.000016	0.000024	0.0015
Ethylbenzene	2.03E-07	0.00024	0.00024	0.000029	0.000044	0.0027
Ethylene Dibromide	1.75E-07	0.00021	0.00021	0.000025	0.000038	0.0023
Formaldehyde	1.68E-04	0.20	0.20	0.024	0.036	2.19
Methanol	2.51E-05	0.030	0.030	0.0036	0.0054	0.33
Methylene Chloride	3.38E-07	0.00041	0.00041	0.000049	0.000073	0.0044
Naphthalene	7.96E-07	0.0010	0.0010	0.00011	0.00017	0.010
PAH	1.16E-06	0.0014	0.0014	0.00017	0.00025	0.015
Styrene	9.76E-08	0.00012	0.00012	0.000014	0.000021	0.0013
Toluene	4.58E-06	0.0055	0.0055	0.00066	0.0010	0.060
Vinyl Chloride	5.89E-08	0.000071	0.000071	0.0000085	0.000013	0.00077
Xylene	1.60E-06	0.0019	0.0019	0.00023	0.00035	0.021
Greenhouse Gases						
CO_2 [d]	0.96	1154	1154	138	208	12531
CH_4 [e]	1.81E-05	0.022	0.022	0.0026	0.0039	0.24
N_2O [e]	1.81E-06	0.0022	0.0022	0.00026	0.00039	0.024
CO_2e [f]	---	1155	1155	139	208	12,544

a Assumes maximum development scenario

b Emission factors compliant with 40 CFR Part 60 Subpart JJJJ for engines > 100 hp with applicable manufacture dates

c AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, converted to lb/hp-hr using 8200 Btu/hp-hr

d 40 CFR Part 98 Subpart

e 40 CFR Part 98 Subpart

f Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Frac Pump Engines

Assumptions:		
Hours of Operation	24	hours/well
Development Rate	89	wells/year
Frac Pump Engines	9,000	hp
Frac Pump Load Factor	0.5	

Frac Pump Emissions - LNG/NG				
	Frac Pump	Frac Pump	Frac Pump	Total
Species	E. Factor	Emissions	Emissions	Emissions [a]
	(lb/hp-hr)	(lb/hr-well)	(tons/yr-well)	(tons/yr)
Criteria Pollutants & VOC				
NOx [b]	2.20E-03	9.92	0.12	10.60
CO [b]	4.41E-03	19.84	0.24	21.19
VOC [b]	1.54E-03	6.94	0.083	7.42
PM_{10} [c]	1.59E-04	0.72	0.0086	0.76
$PM_{2.5}$ [c]	1.59E-04	0.72	0.0086	0.76
SO_2 [c]	4.82E-06	0.022	0.00026	0.023
Hazardous Air Pollutants [c]				
1,1,2,2-Tetrachloroethane	2.07E-07	0.00093	0.000011	0.0010
1,1,2-Trichloroethane	1.25E-07	0.00056	0.0000068	0.00060
1.3-Butadiene	5.44E-06	0.024	0.00029	0.026
1,3-Dichloropropene	1.04E-07	0.00047	0.0000056	0.00050
Acetaldehyde	2.29E-05	0.10	0.0012	0.11
Acrolein	2.16E-05	0.097	0.0012	0.10
Benzene	1.30E-05	0.058	0.00070	0.062
Carbon Tetrachloride	1.45E-07	0.00065	0.0000078	0.00070
Chlorobenzene	1.06E-07	0.00048	0.0000057	0.00051
Chloroform	1.12E-07	0.00051	0.0000061	0.00054
Ethylbenzene	2.03E-07	0.00092	0.000011	0.0010
Ethylene Dibromide	1.75E-07	0.00079	0.0000094	0.00084
Formaldehyde	1.68E-04	0.76	0.0091	0.81
Methanol	2.51E-05	0.11	0.0014	0.12
Methylene Chloride	3.38E-07	0.0015	0.000018	0.0016
Naphthalene	7.96E-07	0.0036	0.000043	0.0038
PAH	1.16E-06	0.0052	0.000062	0.0056
Styrene	9.76E-08	0.00044	0.0000053	0.00047
Toluene	4.58E-06	0.021	0.00025	0.022
Vinyl Chloride	5.89E-08	0.00026	0.0000032	0.00028
Xylene	1.60E-06	0.0072	0.000086	0.0077
Greenhouse Gases				
CO_2 [d]	0.96	4327	52	4,621
CH_4 [e]	1.81E-05	0.082	0.0010	0.087
N_2O [e]	1.81E-06	0.0082	0.00010	0.0087
CO_2e [f]	---	4331	52	4,626

a Assumes maximum development scenario
b Emission factors compliant with 40 CFR Part 60 Subpart JJJJ for engines > 100 hp with applicable manufacture dates
c AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, converted to lb/hp-hr using 8200 Btu/hp-hr
d 40 CFR Part 98 Subpart C, Table C-1
e 40 CFR Part 98 Subpart C, Table C-2
f Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Average Produced Gas Characteristics
Average Gas Analysis Composition from two representative samples

Gas Heat Value (wet): 1296.7 Btu/scf

C1-C2 Wt. Fraction: 0.65
VOC Wt. Fraction: 0.29
Non-HC Wt. Fraction: 0.06
Total: 1.00

Component	Timbro 13-73 Mole Percent	Timbro State LD 16 Mole Percent	Average Mole Percent	Component Mole Weight (lb/lb-mole)	Net Mole Weight (lb/lb-mole)	Weight Percent
Methane	71.3652	70.6879	71.027	16.04	11.395	49.24
Ethane	12.5032	11.8209	12.162	30.07	3.657	15.80
Propane	8.7707	9.0363	8.904	44.10	3.926	16.97
i-Butane	0.7289	0.8247	0.777	58.12	0.451	1.95
n-Butane	2.1841	2.6706	2.427	58.12	1.411	6.10
i-Pentane	0.2803	0.4344	0.357	72.15	0.258	1.11
n-Pentane	0.3313	0.5549	0.443	72.15	0.320	1.38
Cyclopentane	0.0141	0.0292	0.022	70.10	0.015	0.07
Cyclohexane	0.0487	0.0453	0.047	84.16	0.040	0.17
Other Hexanes	0.0649	0.1386	0.102	84.16	0.086	0.37
Heptanes	0.043	0.1122	0.078	100.21	0.078	0.34
Methylcyclohexane	0.0079	0.0226	0.015	98.19	0.015	0.06
Octanes	0.0012	0.009	0.005	114.23	0.006	0.03
Nonanes	0.0005	0.0026	0.002	128.26	0.002	0.01
Decanes +	0.0056	0.0004	0.003	142.29	0.004	0.02
Benzene	0.0121	0.0286	0.020	78.11	0.016	0.07
Toluene	0.0053	0.0133	0.009	92.14	0.009	0.04
Ethylbenzene	0	0.0018	0.001	106.17	0.001	0.00
Xylenes	0.0005	0.0029	0.002	106.17	0.002	0.01
n-Hexane	0.0188	0.107	0.063	86.18	0.054	0.23
2,2,4-TMP	0	0	0.000	114.23	0.000	0.00
Nitrogen	0.9454	1.0634	1.004	28.01	0.281	1.22
Carbon Dioxide	2.6683	2.3932	2.531	44.01	1.114	4.81
Hydrogen Sulfide	0	0	0.000	32.00	0.000	0.00
Total	**100**	**100**	**100**	-	**23.1**	**100.00**

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Operations Tailpipe Emissions

Assumptions:

Total Water Tanker Truck Mileage:	2,737,777	miles/year-all wells
Trucks for LACT downtime:	4,932	miles/year-all wells
Operation Pickup Truck Mileage:	48,655	miles/year-all EcoNodes
Hours of Operation:	10	hours per day

Operations Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions[d] (tons/yr)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions[d] (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NOx	4.98E-02	37.40	68.26	4.39E-03	0.058	0.11	37.46	68.36
CO	1.15E-02	8.63	15.75	2.18E-02	0.29	0.53	8.92	16.28
VOC [c]	1.52E-03	1.14	2.09	1.17E-03	0.016	0.03	1.16	2.12
SO_2	3.65E-05	0.027	0.050	1.75E-05	0.00023	0.0004	0.028	0.051
PM_{10}	2.72E-03	2.04	3.73	8.54E-05	0.0011	0.002	2.05	3.73
$PM_{2.5}$	2.64E-03	1.98	3.62	7.87E-05	0.0010	0.002	1.98	3.62
Greenhouse Gases								
CO_2	5.38E+00	4,042	7,376	1.01E+00	13.40	24.5	4055	7400
CH_4	5.52E-05	0.041	0.076	6.84E-05	0.00091	0.002	0.042	0.077
N_2O	6.04E-06	0.0045	0.008	3.35E-05	0.00045	0.0008	0.0050	0.0091
CO_2e [c]	---	4044	7380	---	13.55	24.7	4057	7405

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.

b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling an average of 30 mph (onsite and offsite) in Weld County, for calendar year 2016.

c Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

d Assumes maximum development scenario

Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Operations Traffic Fugitive Dust Emissions

Public Road Unpaved
AP-42 Chapter 13.2.2, November 2006

$E(PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365)$ Annual

$E(PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2} * (365-p)/365)$ Annual

$E(PM_{10}) / VMT = (1.8 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily

$E(PM_{2.5}) / VMT = (0.18 * (s/12) * (S/30)^{0.5})/(M/0.5)^{0.2}$ Daily

Silt Content (s)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surface Mining Plant Roads
Moisture Content (M)	7.9	%
Average Speed (S)	20.0	mph
Round Trip Miles	23	
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

Control efficiency for water or chemical suppression on unpaved roads 0 %

Industrial Unpaved Calculation
AP-42 Chapter 13.2.2, November 2006

Daily $E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$

Daily $E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$

Annual $E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365)$

Annual $E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365)$

Silt Content (S)	5.1	AP 42 13.2.2-1 Mean Silt Content Western Surf.
Round Trip Miles	2	Mining Plant Roads

Control efficiency for water or chemical suppression on unpaved roads 0 %

Precipitation Days (P) 85.0 days per year (AP-42 Figure 13.2.2-1)

W = average weight in tons of vehicles traveling the road

Paved Calculation AP-42, Chapter 13.2.1
January 2011

Daily $E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$

Daily $E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$

Annual $E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$

Annual $E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$

Silt Loading (sL) 0.6 AP-42 Table 13.2.1-2 baseline low volume roads

W = average weight in tons of vehicles traveling the road

Round Trip Miles	110	miles from Vernal on paved roads estimated
Precipitation Days (P)	85.0	days per year (AP-42 Figure 13.2.2-1)

	Emission Factor		Public Unpaved Road Emissions	
	Daily	Annual		
	lb/VMT	lb/VMT	lb/hr-field	ton/year-field
PM_{10}	0.36	0.28	48.08	67.31
$PM_{2.5}$	0.036	0.028	4.81	6.73

Hours per day 10 hour/day

	Emission Factor		Industrial Unpaved Road Emissions	
	Daily	Annual		
	lb/VMT	lb/VMT	lb/hr-field	ton/year-field
PM_{10}	1.71	1.31	19.59	27.42
$PM_{2.5}$	0.171	0.131	1.96	2.74

Vehicle Type[a]	Weight (lbs)	Round Trips per Day per Field
Haul Trucks	45,000	56
Light Trucks	4,000	1
Mean Vehicle Weight	44,285	---
Total Round Trips	---	57

	Emission Factor		Paved Road Emisions	
	Daily	Annual		
	lb/VMT	lb/VMT	lb/hr	ton/year-well
PM_{10}	0.033	0.031	20.55	35.32
$PM_{2.5}$	0.0080	0.0075	5.04	8.67

Notes:
a Weight of haul trucks, water trucks, and other heavy trucks calculated as average of empty weight (10,000 lbs) and full weight for the round trip (full weight is 80,000 lbs)

Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Condensate Storage Tanks Working, Breathing, and Flashing Emissions

Assumptions:

Production rate	100,303	barrels/yr-well
Total Wells	89	wells
Control efficiency	95	%

Storage tanks receive condensate after a vapor recovery tower/vapor recovery system thus lowering flashing emissions prior to entering tanks.
Storage tanks are further controlled by a 95 % efficient device.

Component	Emission Factor (lb/bbl)	Uncontrolled Emissions (lb/hr-well)	Uncontrolled Emissions (tons/yr-well)	Controlled Emissions (lb/hr-well)	Controlled Emissions (tons/yr-well)	Total Emissions (tons/yr)
VOC [a]	0.78	8.93	39.12	0.45	1.96	174.08
Benzene [a]	0.0055	0.063	0.28	0.00315	0.0138	1.23
n-Hexane [a]	0.036	0.41	1.81	0.0206	0.090	8.03
VOC Subtotal	---	8.93	39.12	0.45	1.96	174.08
HAP Subtotal	---	0.48	2.08	0.0238	0.104	9.26

Notes:
a Emission factor developed from samples from similar locations

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Water Storage Tanks Working, Breathing, and Flashing Emissions

Assumptions:

Production rate	30,000	barrels/yr-well
Total Wells	89	wells
Control efficiency	95	%

Component	Emission Factor (lb/bbl)	Uncontrolled Emissions (lb/hr-well)	Uncontrolled Emissions (tons/yr-well)	Controlled Emissions (lb/hr-well)	Controlled Emissions (tons/yr-well)	Total Emissions (tons/yr)
VOC [a]	0.262	0.90	3.93	0.045	0.20	17.49
Benzene [a]	0.007	0.024	0.11	0.0012	0.0053	0.47
n-Hexane [a]	0.022	0.075	0.33	0.0038	0.017	1.47
VOC Subtotal	---	0.90	3.93	0.045	0.20	17.49
HAP Subtotal	---	0.10	0.44	0.0050	0.022	1.94

Notes:
a Emission factor from CDPHE defaults for Weld County.

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Produced Water Truck Loadout

Assumptions:

Produced Water Production Rate	30000	bbl/year per well
Barrels of oil for LACT downtime	4810	bbl/year
Number of Wells	89	wells

AP - 42, Chapter 5.2 $L_L = 12.46 \times S \times P \times M / T$

L_L = Loading Loss Emission Factor (lbs VOC/1000 gal Loaded)

S = Saturation Factor (0.6 For Submerged Loading - Dedicated Service)

P = True Vapor Pressure of the Loaded Liquid (psi)

M = Vapor Molecular Weight of the Loaded Liquid (lbs/lbmol)

T = Temperature of Loaded Liquid (°R)

	S	P	M	T	L_L lb/1000 gal	VOC tpy-well	VOC tpy [d]
Produced Water Loading [a,b]	0.6	5.2	66	520	0.25	0.0078	0.69
LACT downtime Oil Loading [c]	0.6	5.2	66	520	4.93	0.00028	0.025

Notes:

a Vapor molecular weight and true vapor pressure from AP-42 Chapter 7, Table 7.1-2, assuming the properties of RVP 10 at 60° F.

b Loading Loss emission factor reduced by 95% assuming the produced water will not contain more than 5% hydrocarbons.

c Transportation plan includes 37 haul trucks per year which could be used for LACT downtime. Emissions controlled by 95%

d Assumes maximum development scenario and loading controlled by 95%

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

Operations Pneumatic Emissions

Pneumatic Low Bleed Device	6	scf/hr
Number of Pneumatic Controller per Well	2	devices/well
Number of Wells	89	wells

Gas Component	Molecular Weight (lb/lb-mole)	Mole Percent	Relative Mole Weight (lb/lb-mole)	Weight Percent	Volume Flow Rate (scf/hr-well)	Mass Flow Rate (lb/hr-well)	Mass Flow Rate (tons/yr-well)	Total Mass Flow Rate (tons/yr)
Methane	16.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethane	30.07	0.00	0.00	0.00	0.00	0.00	0.000	0.00
Propane	44.10	0.00	0.00	0.00	0.00	0.00	0.000	0.00
i-Butane	58.12	0.00	0.00	0.00	0.000	0.000	0.000	0.00
n-Butane	58.12	0.00	0.00	0.00	0.00	0.000	0.000	0.00
i-Pentane	72.15	0.00	0.00	0.00	0.000	0.0000	0.000	0.00
n-Pentane	72.15	0.00	0.00	0.00	0.000	0.000	0.000	0.00
Cyclopentane	70.10	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Cyclohexane	84.16	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Other Hexanes	84.16	0.00	0.00	0.00	0.000	0.00000	0.0000	0.00
Heptanes	100.21	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Methylcyclohexane	98.19	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Octanes	114.23	0.00	0.00	0.00	0.00000	0.00000	0.0000	0.000
Nonanes	128.26	0.00	0.00	0.00	0.00000	0.00000	0.0000	0.000
Decanes +	142.29	0.00	0.00	0.00	0.00000	0.00000	0.0000	0.000
Benzene	78.11	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Toluene	92.14	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Ethylbenzene	106.17	0.00	0.00	0.00	0.00000	0.00000	0.0000	0.000
Xylenes	106.17	0.00	0.00	0.00	0.00000	0.00000	0.0000	0.000
n-Hexane	86.18	0.00	0.00	0.00	0.0000	0.00000	0.0000	0.00
Nitrogen	28.01	78.40	21.96	86.38	9.41	0.69440	3.041	270.69
Osygen	16.00	21.50	3.44	13.53	2.58	0.10878	0.476	42.40
Carbon Dioxide	44.01	0.05	0.02	0.09	0.01	0.001	0.003	0.27
	VOC Subtotal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HAP Subtotal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	100.0	25.4	100.0	12.0	0.8	3.5	313.4

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Production Heater Emissions

Separator Heater Size	0.75	MMBtu/hr
Fuel Gas Heat Value	1,020	Btu/scf (Standard heating value from AP-42)
Number of heaters	89	heaters

	Separator Heater			Total Heater	
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/heater)	Total Emissions (tons/yr/heater)	Total Emissions [k] (lb/hr)	Total Emissions [k] (tons/yr)
Criteria Pollutants & VOC					
NOx [a]	100	0.074	0.32	6.54	28.66
CO [a]	84	0.062	0.27	5.50	24.08
VOC [b]	5.5	0.0040	0.018	0.36	1.58
SO_2 [b]	0.6	0.00044	0.0019	0.039	0.17
PM_{10} [b]	7.6	0.0056	0.024	0.50	2.18
$PM_{2.5}$ [b]	7.6	0.0056	0.024	0.50	2.18
Hazardous Air Pollutants					
Benzene [c]	2.10E-03	1.54E-06	6.76E-06	0.00014	0.00060
Toluene [c]	3.40E-03	2.50E-06	1.10E-05	0.00022	0.0010
Hexane [c]	1.80E+00	1.32E-03	5.80E-03	0.12	0.52
Formaldehyde [c]	7.50E-02	5.51E-05	2.42E-04	0.0049	0.021
Dichlorobenzene [c]	1.20E-03	8.82E-07	3.86E-06	0.000079	0.00034
Naphthalene [c]	6.10E-04	4.49E-07	1.96E-06	0.000040	0.00017
POM 2 [c,d,e]	5.90E-05	4.34E-08	1.90E-07	0.0000039	0.000017
POM 3 [c,f]	1.60E-05	1.18E-08	5.15E-08	0.0000010	0.0000046
POM 4 [c,g]	1.80E-06	1.32E-09	5.80E-09	0.00000012	0.00000052
POM 5 [c,h]	2.40E-06	1.76E-09	7.73E-09	0.00000016	0.00000069
POM 6 [c,i]	7.20E-06	5.29E-09	2.32E-08	0.00000047	0.0000021
POM 7 [c,j]	1.8E-06	1.32E-09	5.80E-09	0.00000012	0.00000052
Greenhouse Gases					
CO_2 [l]	119,316	87.7	384.3	7,808	34,200
CH_4 [l]	2.25	0.0017	0.0072	0.15	0.64
N_2O [l]	0.22	0.00017	0.00072	0.015	0.064
CO_2e [m]	---	87.8	384.7	7,816	34,235

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98

b AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98

c AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98

d POM (Particulate Organic Matter) grouped according to subgroups described at EPA's Technology Transfer Network website for the 1999 National-Scale Air Toxics Assessment at http://www.epa.gov/ttn/atw/nata1999/nsata99.html

e POM 2 includes: Acenaphthene, acenaphtylene, anthracene, 2-Methylnaphthalene, benzo(g,h,i)perylene, fluorene, phenanthrene, and pyrene.

f POM 3 includes: 7,12-Dimethylbenz(a)anthracene.

g POM 4 includes: 3-Methylchloranthrene.

h POM 5 includes: Benzo(a)pyrene and dibenzo(a,h)anthracene.

i POM 6 includes: Benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene.

j POM 7 includes: Chrysene.

k Assumes maximum development scenaric

l Subpart W - Part 98.233(z)(1) indicates the use of Table C-1 and Table C-2 for fuel combustion of stationary and portable equipment. Table C-1 provides a CO2 EF for natural gas combustion, and Table C-2 provides CH4 and N2O EF for natural gas combustion.

m Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.

Project: Noble DP East Pony 205/206 EA
Date: 2/27/2015

Fugitive Emissions

Number of Producting Wells 89 wells

Equipment Type and Service	No. of Units[a]	Hours of Operation (hrs/yr)	VOC Weight Fraction[b]	Emission Factor[c] (kg/hr-unit)	Emission Factor (lb/hr-unit)	VOC Emissions (tons/yr)
Valves - Gas	150	8,760	0.29	2.50E-05	5.53E-05	0.010
Valves - Light Oil	48	8,760	0.70	1.90E-05	4.20E-05	0.0062
Valves - Heavy Oil	30	8,760	0.70	8.40E-06	1.86E-05	0.0017
Valves - Water/Lt. Oil	42	8,760	0.70	9.70E-06	2.14E-05	0.0028
Connectors - Gas	60	8,760	0.29	1.00E-05	2.21E-05	0.0017
Connectors - Light Oil	48	8,760	0.70	9.70E-06	2.14E-05	0.0032
Connectors - Heavy Oil	18	8,760	0.70	7.50E-06	1.66E-05	0.00091
Connectors - Water/ Lt. Oil	48	8,760	0.70	1.00E-05	2.21E-05	0.0033
Flange - Gas	168	8,760	0.29	5.70E-06	1.26E-05	0.0027
Flange - Light Oil	72	8,760	0.70	2.40E-06	5.30E-06	0.0012
Flange - Heavy Oil	60	8,760	0.70	3.90E-07	8.62E-07	0.00016
Flange - Water/Lt. Oil	60	8,760	0.70	2.90E-06	6.41E-06	0.0012
Other - Gas	30	8,760	0.29	1.20E-04	2.65E-04	0.010
Other - Light Oil	18	8,760	0.70	1.10E-04	2.43E-04	0.013
Other - Heavy Oil	6	8,760	0.70	3.20E-05	7.07E-05	0.0013
Other - Water/Lt. Oil	18	8,760	0.70	5.90E-05	1.30E-04	0.0072
VOC EMISSIONS (tons/yr-well)						0.067
TOTAL VOC EMISSIONS (tons/yr)[d]						5.97

VOC Emissions (tons/yr) = Emission Factor (lb/hr) * Number of Units * Hours of Operation (hrs/yr) * VOC Wt. Fraction

a Number of components estimated from similar facilities
b Weight fractions from wellsite gas analysis and estimates
c Emission factors from Table 2.8, <10,000 ppmv - Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017
d Estimated at full project production.

	Gas Weight Fraction[b]	Liquid Weight Fraction of VOCs[b]	Total Emissions[d] (tpy)
Benzene Emissions	0.00069	0.0071	0.011
Toluene Emissions	0.00037	---	0.0028
Ethylbenzene Emissions	0.000041	---	0.00032
Xylene Emissions	0.000078	---	0.00060
n-Hexane Emissions	0.00234	0.046	0.056

Equipment Type and Service	No. of Units[a]	Hours of Operation (hrs/yr)	CH_4 Mole Fraction[b]	CO_2 Mole Fraction[b]	Emission Factor[c] (scf/hr/unit)	CH_4 Emissions (tons/yr)	CO_2 Emissions (tons/yr)	CO_2e Emissions (tons/yr)
Valves - Gas	150	8,760	0.71	0.025	0.121	2.39	0.2332	59.97
Connectors - Gas	60	8,760	0.71	0.025	0.017	0.13	0.0131	3.37
Flange - Gas	168	8,760	0.71	0.025	0.031	0.686	0.06693	17.21
Other - Light Oil	30	8,760	0.71	0.025	0.3	1.18	0.1157	29.74
EMISSIONS (tons/yr-well)						4.39	0.4289	110.28
TOTAL GHG EMISSIONS (tons/yr)[d]						391.07	38.17	9,815

a Number of components estimated from similar facilities
b CH_4 and CO_2 mole fractions from wellsite gas analysis
c Emission factors from 40 CFR Part 98, Subpart W, Table W-1A
d Estimated at full project production.

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

EcoNode Flare Emissions

Assumptions:

Number of EcoNodes with controls	4	EcoNodes
Average Flow to flare	2963.8	scf/hr-EcoNode
Average Heating Value of Combusted Gas	2000	Btu/scf
Average Heat Rating per Flare	5.93	MMBtu/hr

	Emission Factor (lb/MMBtu)	Total Emissions (lb/hr-pad)	Total Emissions (tons/yr-pad)	Total Emissions [d] (lb/hr)	Total Emissions [d] (tons/yr)
Criteria Pollutants					
NOx [a]	0.068	0.40	1.77	1.61	7.06
CO [a]	0.37	2.19	9.61	8.77	38.43
VOC [b]	0.011	0.063	0.27	0.25	1.10
SO_2 [b]	0.0012	0.007	0.030	0.027	0.12
PM_{10} [b]	0.015	0.087	0.38	0.35	1.52
$PM_{2.5}$ [b]	0.015	0.087	0.38	0.35	1.52
Hazardous Air Pollutants					
Benzene	4.04E-06	0.000024	0.00010	0.00010	0.00042
Formaldehyde	1.44E-04	0.00085	0.0037	0.0034	0.015
Hexane	3.46E-03	0.021	0.090	0.082	0.36
Toluene	6.54E-06	0.000039	0.00017	0.00015	0.00068
Greenhouse Gases					
CO2 [c]	117.3	695.09	3044.50	2,780	12,178
CH4 [c]	0.0022	0.013	0.057	0.052	0.23
N2O [c]	0.00022	0.0013	0.0057	0.0052	0.023
CO2e [c]	---	695.81	3047.65	2,783	12,191

a AP-42 Section 13.5, Industrial Flares, Table 13.5-1, 9/91

b AP-42 Table 1.4-2 and 1.4-3, Emission Factors for Natural Gas Combustion, 7/98

c Subpart W - Part 98.233(z)(1) indicates the use of Table C-1 and Table C-2 for fuel combustion of stationary and portable equipment. Table C-1 provides a CO2 EF for natural gas combustion, and Table C-2 provides CH4 and N2O EF for natural gas combustion.

c Assumes maximum development scenario

	Project: Noble DP East Pony 205/206 EA Date: 2/27/2015

Lean Burn Compressor Engines

Assumptions:

Number of EcoNodes	4	facilities			
Number of Gas Lift Engines per EcoNode	6	engine	Gas Lift Engine	1,380	hp/engine
Number of Sales Gas Engines per EcoNode	3	engine	Sales Gas Engine	1,380	hp/engine

Pollutant	Emission Factor (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions per engine (lb/hr-lift eng)	Emissions per engine (lb/hr-sales eng)	Emissions per Facility (tons/yr-EcoNode)	Emissions [i] Total (tons/yr)
Criteria Pollutants & VOC						
NOx [a]	-	1.0	3.04	3.04	119.93	479.71
CO [a]	-	2.0	6.08	6.08	239.86	959.43
VOC [a]	-	0.7	2.13	2.13	83.95	335.80
PM_{10} [b,c]	9.95E-03	3.70E-02	0.11	0.11	4.44	17.75
$PM_{2.5}$ [b,c]	9.95E-03	3.70E-02	0.11	0.11	4.44	17.75
SO_2 [b]	5.88E-04	2.19E-03	0.0067	0.0067	0.26	1.05
Hazardous Air Pollutants [b]						
Benzene	4.40E-04	1.64E-03	0.0025	0.0025	0.10	0.39
Toluene	4.08E-04	1.52E-03	0.0023	0.0023	0.09	0.36
Ethylbenzene	3.97E-05	1.48E-04	0.00022	0.00022	0.009	0.035
Xylenes	1.84E-04	6.84E-04	0.0010	0.0010	0.041	0.16
n-Hexane	1.11E-03	4.13E-03	0.0063	0.0063	0.25	0.99
Formaldehyde	5.28E-02	1.96E-01	0.30	0.30	11.77	47.10
Acetaldehyde	8.36E-03	3.11E-02	0.047	0.047	1.86	7.46
Acrolein	5.14E-03	1.91E-02	0.029	0.029	1.15	4.59
Methanol	2.50E-03	9.30E-03	0.014	0.014	0.56	2.23
1,1,2,2-Tetrachloroethane	4.00E-05	1.49E-04	0.00023	0.00023	0.009	0.036
1,1,2-Trichloroethane	3.18E-05	1.18E-04	0.00018	0.00018	0.0071	0.028
1,3-Dichloropropene	2.64E-05	9.82E-05	0.00015	0.00015	0.0059	0.024
1,3-Butadiene	2.67E-04	9.93E-04	0.0015	0.0015	0.060	0.24
2,2,4-Trimethylpentane	2.50E-04	9.30E-04	0.0014	0.0014	0.056	0.22
Biphenyl	2.12E-04	7.88E-04	0.0012	0.0012	0.047	0.19
Carbon Tetrachloride	3.67E-05	1.36E-04	0.00021	0.00021	0.008	0.033
Chlorobenzene	3.04E-05	1.13E-04	0.00017	0.00017	0.0068	0.027
Chloroform	2.85E-05	1.06E-04	0.00016	0.00016	0.0064	0.025
Ethylene Dibromide	4.43E-05	1.65E-04	0.00025	0.00025	0.010	0.040
Methylene Chloride	2.00E-05	7.44E-05	0.00011	0.00011	0.0045	0.018
Naphthalene	7.44E-05	2.77E-04	0.00042	0.00042	0.017	0.066
Phenol	2.40E-05	8.93E-05	0.00014	0.00014	0.0054	0.021
Styrene	2.36E-05	8.78E-05	0.00013	0.00013	0.0053	0.021
Tetrachloroethane	2.48E-06	9.22E-06	0.000014	0.000014	0.00055	0.0022
Vinyl Chloride	1.49E-05	5.54E-05	0.000084	0.000084	0.0033	0.013
PAH -POM 1 [d,e]	2.69E-05	1.00E-04	0.00015	0.00015	0.0060	0.024
POM 2 [d,f]	5.93E-05	2.21E-04	0.00034	0.00034	0.013	0.053
Benzo(b)fluoranthene/POM6	1.66E-07	6.17E-07	0.00000094	0.00000094	0.000037	0.00015
Chrysene/POM7	6.93E-07	2.58E-06	0.0000039	0.0000039	0.00015	0.00062
Greenhouse Gases						
CO_2 [g]	117	435	1,324	1,324	52,173	208,692
CH_4 [g]	0.0022	0.0082	0.025	0.025	0.98	3.93
N_2O [g]	0.00022	0.00082	0.0025	0.0025	0.098	0.39
CO_2e [h]	---	---	1,325	1,325	52,227	208,908

a 40 CFR Part 60 Subpart JJJJ compliant engines
b AP-42 Table 3.2-2 Uncontrolled Emission Factors for a 4 stroke Lean Burn engine, 7/2000, converted to g/hp-hr with a BSFC of 8200 Btu/hp-hr. HAPs are reduced by 50% control efficiency for a catalyst.
c PM = sum of PM filterable and PM condensable
d Polycyclic Aromatic Hydrocarbons (PAH) defined as a HAP by Section 112(b) of the Clean Air Act because it is Polycyclic Organic Matter (POM) AP-42 Table 1.4-3 footnotes.
e POM (Particulate Organic Matter) grouped according to subgroups described at EPA's Technology Transfer Network website for the 1999 National-Scale Air Toxics Assessment at http://www.epa.gov/ttn/atw/nata1999/nsata99.html
f POM 2 includes: Acenaphthene, acenaphtylene, 2-Methylnaphthalene, benzo(e)pyrene, benzo(g,h,i)perylene, fluoranthene, fluorene, phenanthrene, and pyrene.
g Subpart W - Part 98.233(z)(1) indicates the use of Table C-1 and Table C-2 for fuel combustion of stationary and portable equipment. Table C-1 provides a CO2 EF for natural gas combustion, and Table C-2 provides CH4 and N2O EFs for natural gas combustion.
h Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.
i Assumes maximum development scenario

Project: Noble DP East Pony 205/206 EA

Date: 2/27/2015

VRU Compressor Engines

Assumptions:

Number of EcoNodes	4	facilities
Number of VRU Engines per EcoNode	6	engine
VRU Engine Rating	150	hp

Pollutant	Emission Factor (g/hp-hr)	Emissions per engine (lb/hr-VRU eng)	Emissions per Facility (tons/yr-EcoNode)	Emissions [g] Total (tons/yr)
Criteria Pollutants & VOC				
NOx [b]	1.0	0.33	8.69	34.76
CO [b]	2.0	0.66	17.38	69.53
VOC [b]	0.7	0.23	6.08	24.33
PM_{10} [c]	7.22E-02	0.024	0.63	2.51
$PM_{2.5}$ [c]	7.22E-02	0.024	0.63	2.51
SO_2 [c]	2.19E-03	0.00072	0.019	0.076
Hazardous Air Pollutants [c]				
1,1,2,2-Tetrachloroethane	9.41E-05	0.000016	0.00041	0.0016
1,1,2-Trichloroethane	5.69E-05	0.0000094	0.00025	0.0010
1.3-Butadiene	2.47E-03	0.00041	0.011	0.043
1,3-Dichloropropene	4.72E-05	0.0000078	0.00021	0.00082
Acetaldehyde	1.04E-02	0.0017	0.045	0.18
Acrolein	9.78E-03	0.0016	0.043	0.17
Benzene	5.88E-03	0.00097	0.026	0.10
Carbon Tetrachloride	6.58E-05	0.000011	0.00029	0.0011
Chlorobenzene	4.80E-05	0.0000079	0.00021	0.00083
Chloroform	5.10E-05	0.0000084	0.00022	0.00089
Ethylbenzene	9.22E-05	0.000015	0.00040	0.0016
Ethylene Dibromide	7.92E-05	0.000013	0.00034	0.0014
Formaldehyde	7.62E-02	0.013	0.33	1.33
Methanol	1.14E-02	0.0019	0.049	0.20
Methylene Chloride	1.53E-04	0.000025	0.00067	0.0027
Naphthalene	3.61E-04	0.000060	0.0016	0.0063
PAH	5.24E-04	0.000087	0.0023	0.0091
Styrene	4.43E-05	0.0000073	0.00019	0.00077
Toluene	2.08E-03	0.00034	0.0090	0.036
Vinyl Chloride	2.67E-05	0.0000044	0.00012	0.00046
Xylene	7.25E-04	0.00012	0.0032	0.013
Greenhouse Gases				
CO_2 [d]	436.2	144	3,790	15,162
CH_4 [e]	8.22E-03	0.0027	0.071	0.29
N_2O [e]	8.22E-04	0.00027	0.0071	0.029
CO_2e [f]	---	144	3,794	15,177

a Assumes maximum development scenario
b Emission factors compliant with 40 CFR Part 60 Subpart JJJJ for engines > 100 hp with applicable manufacture dates
c AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, converted to lb/hp-hr using 8200 Btu/hp-hr. HAPs are reduced by 50% control efficiency for a catalyst.
d 40 CFR Part 98 Subpart C, Table C-1
e 40 CFR Part 98 Subpart C, Table C-2
f Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.
g Assumes maximum development scenario

Project: Noble DP East Pony 205/206 EA

Date: 2/24/2015

Generator for Air Compressors

Assumptions:

Number of EcoNodes	4	facilities
Number of Generagor Engines per EcoNode	1	engine
Generator Engine Rating	272	hp

Pollutant	Emission Factor (g/hp-hr)	Emissions per engine (lb/hr-generator)	Emissions per Facility (tons/yr-EcoNode)	Emissions [g] Total (tons/yr)
Criteria Pollutants & VOC				
NOx [b]	1.0	0.60	2.63	10.51
CO [b]	2.0	1.20	5.25	21.01
VOC [b]	0.7	0.42	1.84	7.35
PM_{10} [c]	7.22E-02	0.043	0.19	0.76
$PM_{2.5}$ [c]	7.22E-02	0.043	0.19	0.76
SO_2 [c]	2.19E-03	0.00131	0.006	0.023
Hazardous Air Pollutants [c]				
1,1,2,2-Tetrachloroethane	9.41E-05	0.000028	0.00012	0.00049
1,1,2-Trichloroethane	5.69E-05	0.0000171	0.00007	0.00030
1.3-Butadiene	2.47E-03	0.00074	0.003	0.013
1,3-Dichloropropene	4.72E-05	0.0000142	0.00006	0.00025
Acetaldehyde	1.04E-02	0.0031	0.014	0.055
Acrolein	9.78E-03	0.0029	0.013	0.051
Benzene	5.88E-03	0.00176	0.0077	0.031
Carbon Tetrachloride	6.58E-05	0.000020	0.000086	0.00035
Chlorobenzene	4.80E-05	0.0000144	0.000063	0.00025
Chloroform	5.10E-05	0.0000153	0.000067	0.00027
Ethylbenzene	9.22E-05	0.000028	0.00012	0.00048
Ethylene Dibromide	7.92E-05	0.000024	0.00010	0.00042
Formaldehyde	7.62E-02	0.023	0.10	0.40
Methanol	1.14E-02	0.0034	0.015	0.060
Methylene Chloride	1.53E-04	0.000046	0.00020	0.00080
Naphthalene	3.61E-04	0.000108	0.00047	0.0019
PAH	5.24E-04	0.000157	0.00069	0.0028
Styrene	4.43E-05	0.0000133	0.000058	0.00023
Toluene	2.08E-03	0.00062	0.0027	0.011
Vinyl Chloride	2.67E-05	0.0000080	0.000035	0.00014
Xylene	7.25E-04	0.00022	0.0010	0.0038
Greenhouse Gases				
CO_2 [d]	436.2	262	1,146	4,582
CH_4 [e]	8.22E-03	0.0049	0.022	0.09
N_2O [e]	8.22E-04	0.00049	0.0022	0.009
CO_2e [f]	---	262	1,147	4,587

a Assumes maximum development scenario
b Emission factors compliant with 40 CFR Part 60 Subpart JJJJ for engines > 100 hp with applicable manufacture dates
c AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, converted to lb/hp-hr using 8200 Btu/hp-hr. HAPs are reduced by 50% control efficiency for a catalyst.
d 40 CFR Part 98 Subpart C, Table C-1
e 40 CFR Part 98 Subpart C, Table C-2
f Global warming potential calculated using factors in 40 CFR Part 98, Subpart A, Table A-1.
g Assumes maximum development scenario

Noble Energy -

89	Total Wells	Proposed Action January 2015
14	New Well Pads	Proposed Action January 2015
1	Existing Well Pad	Proposed Action January 2015
4	New EcoNodes	Proposed Action January 2015
1	Development Years	Call with Shaun Higgins on Sept 8, 2014
1	Water wells	Proposed Action January 2015

		Units	Source
Construction			
Well Pad Construction			
Well pad equipment days per site (no grader)	4	days/well pad	Proposed Action January 2015, Table 1 - divide total days between various activities
Well pad grader days	2	days/well pad	Call with Shaun Higgins on Sept 8, 2014
Well pad disturbance	8.56	acres/well pad	Proposed Action January 2015 - Table 5 average
Well pad grading swaths	39	swaths	Assumes 14 ft grader blade and 550 ft width well pad
Well pad grading distance	4.95	miles/pad	670 ft length x 39 swaths / 5280 ft/mi
Existing well pad initial disturbance	1.30	acres/well pad	Proposed Action January 2015 - Table 5
Water Well Pad Construction			
Well pad equipment days per site (no grader)	6	days/well pad	Email from Shaun Higgins to Michele Steyskal September 17, 2014
Well pad grader days	0	days/well pad	Email from Shaun Higgins to Michele Steyskal September 17, 2014
Well pad disturbance	1	acres/well pad	Proposed Action January 2015 - Table 5
Water well pad grading swaths	15	swaths	Assumes 14 ft grader blade and 210 ft width well pad
Water well pad grading distance	0.60	miles/pad	210 ft length x 15 swaths / 5280 ft/mi
EcoNode Construction			
Well pad equipment days per site (no grader)	4	days/EcoNode	Call with Shaun Higgins on Sept 8, 2014
Well pad grader days	3	days/EcoNode	Call with Shaun Higgins on Sept 8, 2014
EcoNode disturbance	19.3	acres/EcoNode	Proposed Action January 2015 - Table 5 average
EcoNode pad grading swaths	66	swaths	Assumes 14 ft grader blade and 920 ft width well pad
EcoNode pad grading distance	11.50	miles/pad	920 ft length x 66 swaths / 5280 ft/mi
Road Construction			
New road mileage	2.2	miles	February 6, 2015 email from ICF to Kleinfelder
Existing road mileage	1.9	miles	Proposed Action January 2015
Road ROW width	40	feet	Proposed Action January 2015
Road mileage per well pad	0.29	miles/pad	(2.2 miles + 1.9 miles)/14 well pads
Road construction equipment days per mile (no grader)	2	days/mile	Typical parameter
Road grader days per mile	2	days/mile	Call with Shaun Higgins on Sept 8, 2014
Road grading swaths	3	swaths	ROW width / 14 ft grader blade
Road Grading Length	12	miles	4.1 miles * 3 swaths

Pipeline Construction				
	New oil/gas pipeline mileage (flowlines-well to EcoNode)	2.7	miles	Proposed Action January 2015
	New oil/gas pipeline mileage (gathering-EcoNode to infrastructure)	2.1	miles	February 6, 2015 email from ICF to Kleinfelder
	New buried water pipeline (fresh water to ponds)	1.1	miles	February 6, 2015 email from ICF to Kleinfelder
	New surface water pipeline (from ponds to wells)	5.6	miles	Proposed Action January 2015
	Oil/gas pipeline ROW width	150	feet	Proposed Action January 2015
	Water pipeline ROW width	100	feet	Proposed Action January 2015
	Pipeline construction equipment days per mile (no grader)	4	days/mile	Call with Shaun Higgins on Sept 8, 2014
	Pipeline grader days per mile	1	days/mile	Typical parameter
	Road grading swaths-oil and gas	11	swaths	ROW width / 14 ft grader blade
	Road grading swaths-water	7	swaths	ROW width / 14 ft grader blade
	Road Grading Length	61	miles	4.8 miles * 11 swaths + 1.1 miles * 7 swaths
Interim Reclamation				
	Interim reclamation hours per day	12	hours/day	Call with Shaun Higgins on Sept 8, 2014
	Interim reclamation days per well pad	4	days/well pad	Call with Shaun Higgins on Sept 8, 2014
	Interim reclamation haul trucks	2	trips/well pad	Assumed value
	Interim reclamation light trucks	2	trips/well pad	Assumed value
General Construction Parameters				
	New Well pad/road construction hours of operation	12	hrs/day	Call with Shaun Higgins on Sept 8, 2014
	Control Efficiency-Dust control	50	% - Watering	Call with Shaun Higgins on Sept 8, 2014
	Total initial disturbance for pads	200	acres	Proposed Action January 2015 - Table 5
	Total initial disturbance for roads/pipelines	106	acres	Proposed Action January 2015 - Table 5
	Total long term disturbance for pads	127	acres	Proposed Action January 2015 - Table 5
	Total long term disturbance for roads/pipelines	14	acres	Proposed Action January 2015 - Table 5
	Mileage for construction and production	23.30	miles on unpaved roads-round trip	
		110.00	miles on paved roads-round trip	
	Well Pad/Road construction heavy truck trips	32	trips/well pad	Proposed Action January 2015 - Table 1
	Well Pad/Road construction light truck trips	16	trips/well pad	Proposed Action January 2015 - Table 1
	Water well pad construction heavy truck trips	24	trips/well pad	Proposed Action January 2015- scaled from well pad/road construction
	Water well pad construction light truck trips	12	trips/well pad	Proposed Action January 2015- scaled from well pad/road construction
	EcoNode construction 42.5 ton truck trips	1	trips/EcoNode	Noble Scenario 1 spreadsheet
	EcoNode construction 27 ton truck trips	46	trips/EcoNode	Noble Scenario 1 spreadsheet
	EcoNode construction 4 ton truck trips	74	trips/EcoNode	Noble Scenario 1 spreadsheet - minus trips for light trucks on well pads

Drilling				
	Maximum wells drilled per year	89	wells/year	Assume 1 year of development
	Drilling hours	24	hours/day	Call with Shaun Higgins on Sept 8, 2014
	Drilling days	10	days/well	Proposed Action January 2015 - Page 2
	Rig horsepower	2400	hp	Call with Shaun Higgins on Sept 8, 2014
	Type of engine fuel	NG		Call with Shaun Higgins on Sept 8, 2014
	Drilling day for a water well	15	days/well	Email from Shaun Higgins to Michele Steyskal September 17, 2014
	Heavy trucks needed for drilling	70	round trips/well	Proposed Action January 2015 - Table 1
	Light trucks needed for drilling	140	round trips/well	Proposed Action January 2015 - Table 1
	Heavy trucks needed for water well drilling	105	round trips/well	Scaled from oil well drilling traffic
	Light trucks needed for water well drilling	210	round trips/well	Scaled from oil well drilling traffic
Completion				
	Well completion hours per day	24	hours/day	Call with Shaun Higgins on Sept 8, 2014
	Well completion days	7	days/well	Proposed Action January 2015 - Page 2
	Hours per frac job	24	hours/well	Call with Shaun Higgins on Sept 8, 2014
	Well Venting duration during completion	N/A	hrs/event	Call with Shaun Higgins on Sept 8, 2014
	Well venting during completion amount	N/A	MMscf/event	Call with Shaun Higgins on Sept 8, 2014
	Well venting events during completion	N/A	event/well/completion	Call with Shaun Higgins on Sept 8, 2014
	Typical horsepower for a frac engine	9,000	hp	Noble Scenario 1 spreadsheet
	Type of engine fuel	NG		Noble Scenario 1 spreadsheet
	Well completion heavy trucks	91	round trips/well	Proposed Action January 2015 - Table 1
	Well completion light trucks	105	round trips/well	Proposed Action January 2015 - Table 1
EcoNodes				
	Oil Production	100,303	bbl/yr-well	Noble Scenario 1 spreadsheet
	Produced Water	30,000	bbl/yr-well	Noble Scenario 1 spreadsheet
	Tanker Truck Size	130	barrels/truck	Call with Shaun Higgins on Sept 8, 2014
	Trucks for LACT downtime	37	trucks/year	Transportation plan
	Operations Pickup Truck Trips	1	roundtrips/day-All EcoNodes	Proposed Action January 2015 - based on EcoNode rather than per well as Table 2 shows
	Hours per Day	10	hr/day	Call with Shaun Higgins on Sept 8, 2014
	Tank Control Efficiency	95	%	Call with Shaun Higgins on Sept 8, 2014
	Number of separator heaters	1	heater/well	Call with Shaun Higgins on Sept 8, 2014
	Separator heater	0.75	MMBtu/hr-heater	Call with Shaun Higgins on Sept 8, 2014
	Number of Compressor Engines-Gas Lift	6	engines/EcoNode	Noble Scenario 1 spreadsheet
	Size of Compressor Engines-Gas Lift	1,380	hp	Noble Scenario 1 spreadsheet
	Number of Compressor Engines-Sales	3	engines/EcoNode	Noble Scenario 1 spreadsheet
	Size of Compressor Engines-Sales	1,380	hp	Noble Scenario 1 spreadsheet
	Number of Compressor Engines-VRU	6	engines/EcoNode	Noble Scenario 1 spreadsheet
	Size of Compressor Engines-VRU	150	hp	Noble Scenario 1 spreadsheet
	Horsepower of pumping unit	N/A	hp	Call with Shaun Higgins on Sept 8, 2014
	Number of Pneumatic Device at each EcoNode	2	devices	Assumed value

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APPENDIX C-2

NEAR-FIELD AIR QUALITY MODELING ASSESSMENT

NOBLE DP 205/206 ENVIRONMENTAL IMPACTS ASSESSMENT – AIR QUALITY NEAR-FIELD IMPACTS MODELING ANALYSIS

A near-field ambient air quality impact assessment was performed to quantify and evaluate maximum air pollutant impacts at nearby residences and Pawnee National Grasslands ambient receptors within the vicinity of the project area resulting from proposed oil and gas development (drilling, etc.) and production (operation phase) related emissions for four near-field modeling scenarios. USEPA's recommended guideline model, AERMOD, with northeast Colorado surface meteorology was used to predict near-field impacts at the "sensitive" receptors.

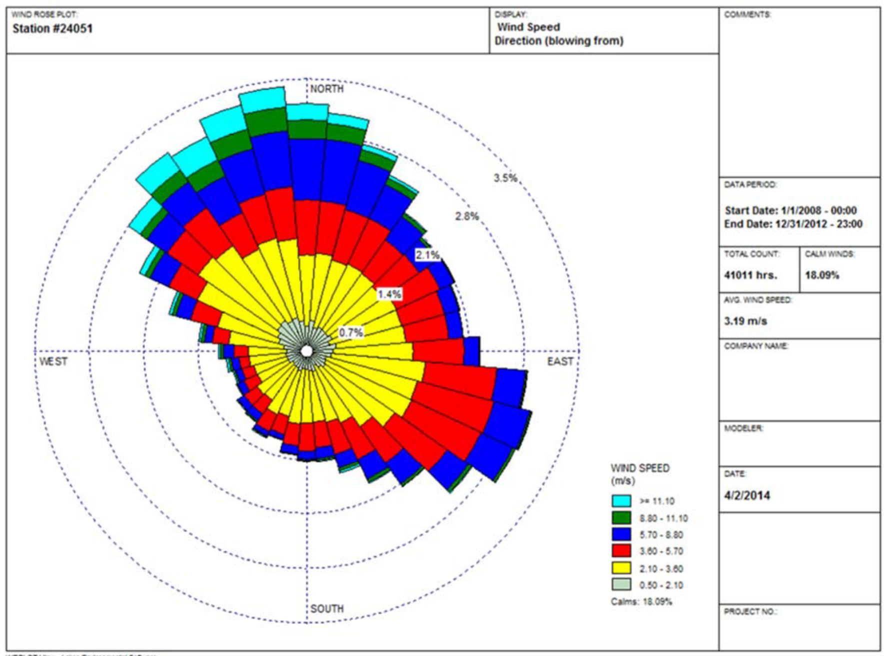
The near-field modeling analysis includes predicted maximum 1-hour average ambient concentrations for nitrogen dioxide (NO_2), benzene, ethylbenzene, formaldehyde, n-hexane, toluene and xylene; 24-hour average concentrations of PM_{10} and $PM_{2.5}$; and annual $PM_{2.5}$, benzene, ethylbenzene, formaldehyde, n-hexane, toluene and xylene concentrations.

The following sections of this modeling report provide details for the near-field modeling analysis that was conducted for the proposed action environmental assessment.

MODELING INPUTS AND METHODOLOGY

Meteorology

Meteorological surface data was collected from a National Weather Service (NWS) Automated Surface Observation System at Greeley, Colorado Airport (24051) located at 40.44N, 104.63W for five years (2008 – 2012). Data collected at the surface meteorological station for the creation of the near-field modeling dataset included numerous parameters such as wind speed, wind direction, temperature, relative humidity, cloud cover, atmospheric pressure, visibility, and precipitation. Upper air radiosonde data was collected by the National Weather Service in Denver, Colorado, located at 39.77N, 104.88W. The complete aggregation of raw monitored meteorological data values was processed by AERMET with monthly values for albedo, Bowen ratio, and surface roughness length derived specifically for the Greeley, Colorado Airport to produce an AERMOD ready dataset. The following image shows a wind speed and direction frequency wind-rose for the northeastern Colorado meteorology dataset used for this modeling assessment.



Near-field Modeling Domain

The near-field modeling domain was established to include nearby existing emissions sources and sensitive receptors (residences, etc.) out to 12 kilometers in all directions from the approximate center of the proposed project area. The following plot shows the AERMOD near-field modeling domain boundary with locations of sensitive receptors (large yellow circles for residences and green circles for Pawnee National Grasslands), and criteria pollutant (small red hexagons) and hazardous air pollutants (small orange hexagons) nearby / existing emissions sources included in the analysis. Note that some of the GIS shapes (red hexagons) for criteria pollutant emissions sources overlap / cover-up shapes for hazardous air pollutants emissions sources. The proposed project area is in the center of the modeling domain circle with purple / pink colored shapes. A portion of the current Denver / Front Range 8-hour ozone non-attainment area (NAA) is also shown in the plot.

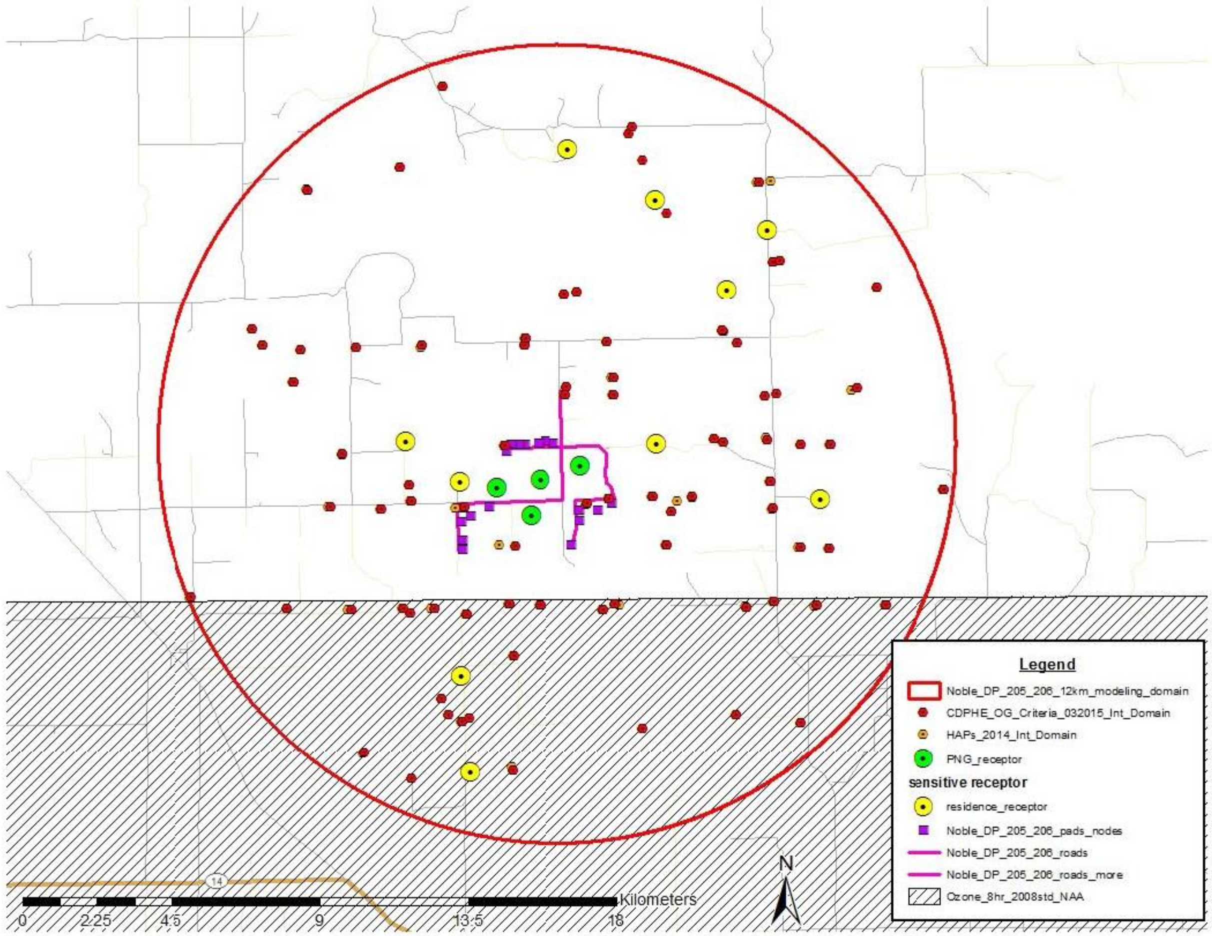


Figure 1. Near-Field Modeling Domain

Terrain and Base Elevations

ArcGIS and 10 meter resolution terrain data were used to determine base elevations and topography for the nearby existing and proposed project emissions sources and sensitive receptors included in the near-field modeling analysis.

Proposed Action Near-Field Modeling Scenarios – Setup and Emissions

Near-field ambient air models were created with AERMOD to assess potential air quality impacts from oil and gas development and production related activities. To realistically estimate potential near-field impacts within 12 kilometers of the proposed project, proposed project and existing nearby source activities were modeled together for the AERMOD modeling analysis. The proposed project proponent provided emissions estimates and detailed temporal schedules for construction and development activities to the BLM to use for developing the near-field modeling scenarios and inputs. Four near-field modeling scenarios were developed for this near-field modeling analysis based on construction / development schedules that capture the different phases for the proposed project, and the following provides details for the modeling scenarios:

- Scenario 1: construction and development activities with no production activities – four pads with drill rigs (drill rig engines in operation); four EcoNodes pads / areas under construction (equipment operation and surface disturbance); south-west road segment improvement (equipment operation and surface disturbance); and construction / development traffic.
- Scenario 2: construction and development activities with no production activities – one pad with drill rig (drill rig engines in operation); three pads with fracking / completion activities (fracking / completion engines in operation); south-west road segment improvement (equipment operation and surface disturbance); and construction / development traffic.
- Scenario 3: construction and development activities with partial production activities – three pads with drill rigs (drill rig engines in operation); four EcoNodes in full or partial operations (engine / equipment operations, fugitives, tanks, etc.); two well-pads being constructed (equipment operation and surface disturbance); south-west road segment improvement (equipment operation and surface disturbance); and construction / development and production related traffic.
- Scenario 4: full production operations - four EcoNodes in full operations (engine / equipment operations, fugitives, tanks, etc.); and production related traffic.

The following sub-sections provide more details on the near-field modeling scenarios including emissions rates modeled and the layouts.

Scenario 1 – Construction / Development

For Scenario 1, there were four well-pads with drill-rig engines: Beretta Federal, Browning Federal, Ringo Federal and Earp Federal; four EcoNodes being constructed (surface disturbance, etc.): LC 11-15, LC 24-6, LC 11-13 and LC 22; southwest road segment improvement activities and construction / development traffic. The drill rig engines were modeled with point sources (one point source per pad) and the EcoNode pad construction (one volume source per pad), road improvement (15 volume sources for length of road segment to be improved) and traffic (136 volume source distributed over network of proposed project roadways) activities were modeled using volume sources in AERMOD. The following table shows the emissions rates modeled for each point or volume source for each activity:

Table 1a. Criteria Pollutants Emissions Rates (grams / second) Modeled for Project Sources – Scenario 1

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
Drill Rigs	0.33333	0.02407	0.02407
EcoNode Construction	0.31588	0.09362	0.04457
Southwest Road Improvement	0.02106	0.00444	0.00278
Road Traffic	0.00179	0.02527	0.00260

*drill rig engines emissions rates released from each of the four well-pad point sources

*EcoNode construction emissions rates released from each of the four EcoNode pad volume sources

*southwest road improvement emissions rates released from each of the 15 volume sources allocated for this emissions group activity

*traffic related emissions rates released from each of the 136 volume sources allocated for this emissions group activity

Table 1b. HAPs Emissions Rates (grams / second) Modeled for Project Sources – Scenario 1

Emissions Source Activity	Formaldehyde	Benzene	Ethyl-benzene	Toluene	Xylene
Drill Rigs	0.02542	0.00196	0.00003	0.00069	0.00024

*drill rig engines emissions rates released from each of the four well-pad point sources

The following plot shows the proposed project emissions source layout for Scenario 1. The layout is based on project proponent provided information for the proposed project. The closest sensitive receptors in the vicinity (few miles) of the proposed project and Pawnee National Grasslands surface areas are also shown in the plot.

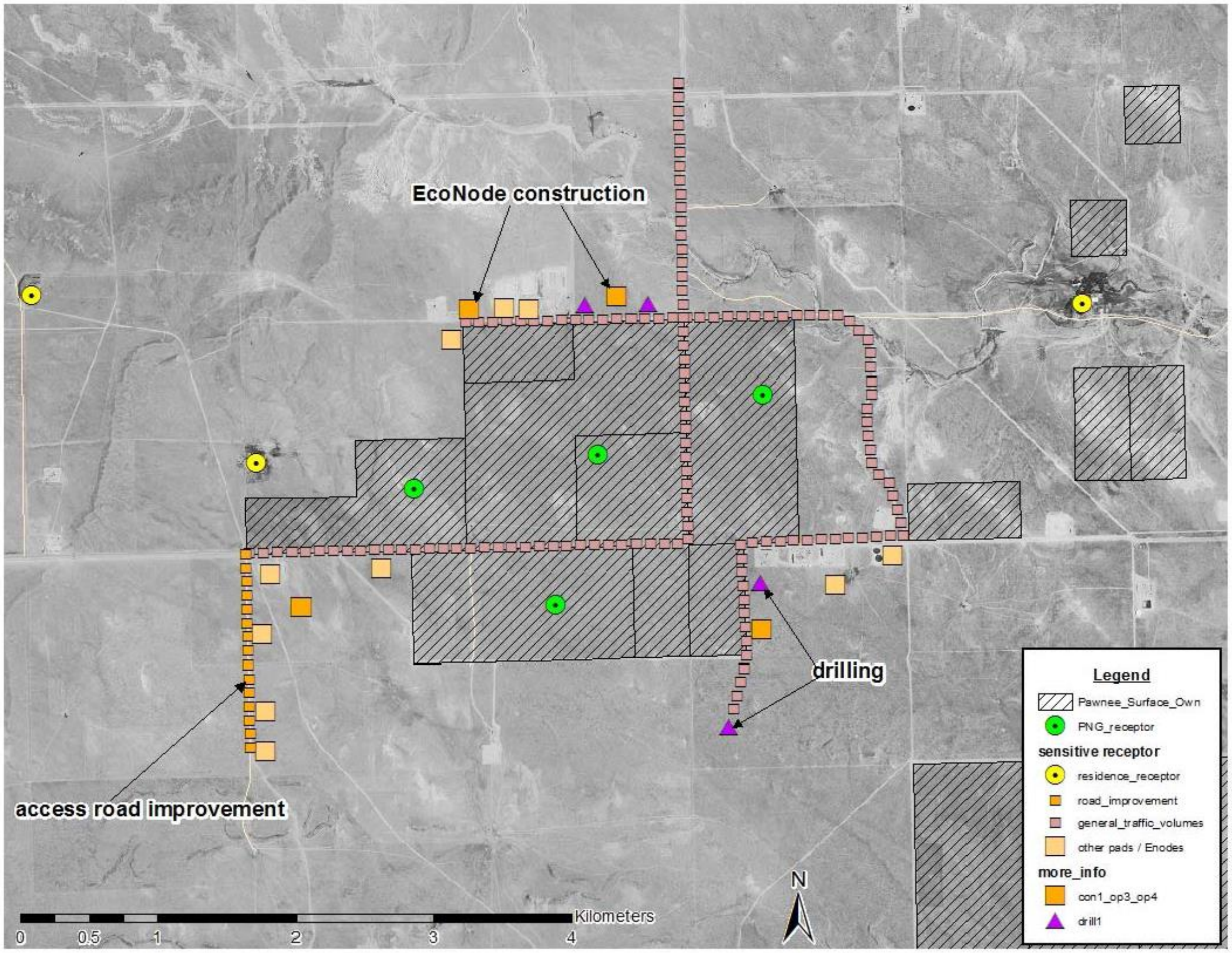


Figure 2. Proposed Project Emissions Source Layout - Scenario 1

Scenario 2 – Construction / Development

For Scenario 2, there was one well-pad with drill-rig engines: Winchester Federal; three well-pads with fracking / completion activities and engines: Magpul Federal, Dukes Federal and Holliday Federal; southwest road segment improvement activities and construction / development traffic. The drill rig and completion engines were modeled with point sources (one point source per pad) and the road improvement (15 volume sources for length of road segment to be improved) and traffic (136 volume source distributed over network of proposed project roadways) activities were modeled using volume sources in AERMOD. The following table shows the emissions rates modeled for each point or volume source for each activity:

Table 2a. Criteria Pollutants Emissions Rates (grams / second) Modeled for Project Sources – Scenario 2

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
Drill Rigs	0.33333	0.02407	0.02407
Fracking / Completion	1.25000	0.09025	0.09025
Southwest Road Improvement	0.02106	0.00444	0.00278
Road Traffic	0.00097	0.01183	0.00123

*drill rig engines emissions rates released from the one well-pad point source
*fracking / completion engines emission rates from each of the three well-pad point sources
*southwest road improvement emission rates from each of the 15 volume sources allocated for this emissions group activity
*traffic related emission rates from each of the 136 volume sources allocated for this emissions group activity

Table 2b. HAPs Emissions Rates (grams / second) Modeled for Project Sources – Scenario 2

Emissions Source Activity	Formaldehyde	Benzene	Ethyl-benzene	Toluene	Xylene
Drill Rigs	0.02542	0.00196	0.00003	0.00069	0.00024
Fracking / Completion	0.09531	0.00735	0.00012	0.00259	0.00091

*drill rig engines emissions rates released from the one well-pad point source
*fracking / completion engines emissions rates released from each of the three well-pad point sources

The following plot shows the proposed project emissions source layout for Scenario 2. The layout is based on project proponent provided information for the proposed project. The closest sensitive receptors in the vicinity (few miles) of the proposed project and Pawnee National Grasslands surface areas are also shown in the plot.

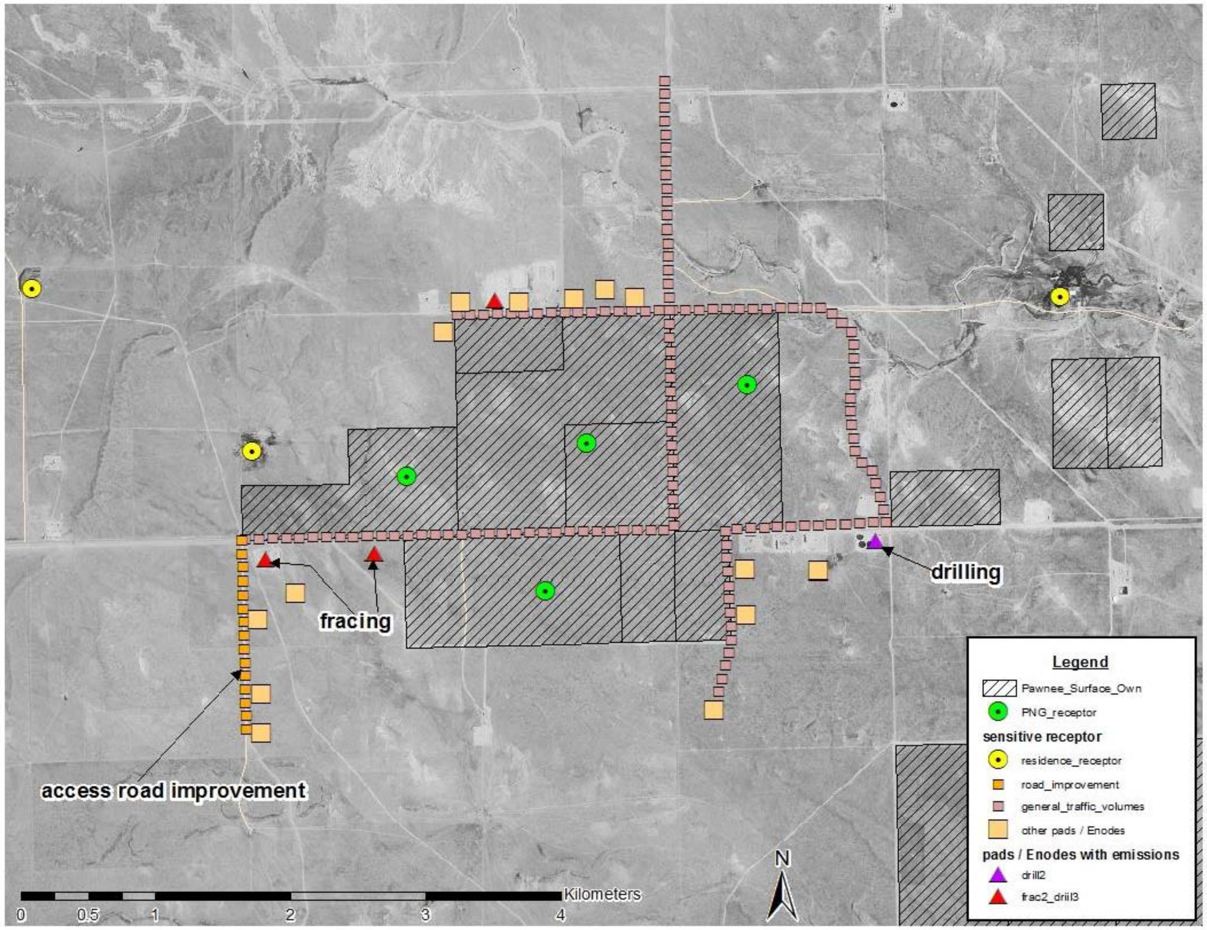


Figure 3. Proposed Project Emissions Source Layout - Scenario 2

Scenario 3 - Construction / Development with Partial Operations

For Scenario 3, there were three well-pads with drill-rig engines: Magpul Federal, Dukes Federal and Kramer Federal; four EcoNodes with full or partial operations: LC 11-15 (56% of full operation), LC 24-6 (100% of full operation), LC 11-13 (40% of full operation) and LC 22 (27% of full operation); two well-pads with construction activities (surface disturbance, etc.): Minutemen Federal and Constitution Federal; southwest road segment improvement activities and construction / development and production related traffic. The drill rig and EcoNode engines were modeled with point sources (one point source per pad / EcoNode) and the pad construction (one volume source per pad), road improvement (15 volume sources for length of road segment to be improved) and traffic (151 volume source distributed over the entire network of proposed project roadways) activities were modeled using volume sources in AERMOD. The following table shows the emissions rates modeled for each point or volume source for each activity:

Table 3a. Criteria Pollutants Emissions Rates (grams / second) Modeled for Project Sources – Scenario 3

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
Drill Rigs	0.33333	0.02407	0.02407
EcoNode Operation – LC24-6	4.03249	0.17770	0.17770
EcoNode Operation – LC11-15	2.26828	0.09996	0.09996
EcoNode Operation – LC11-13	1.61300	0.07108	0.07108
EcoNode Operation – LC22	1.08986	0.04803	0.04803
Well-pad Construction	0.31588	0.08262	0.04338
Southwest Road Improvement	0.02106	0.00444	0.00278
Road Traffic	0.00307	0.04230	0.00437

*drill rig engines emissions rates released from each of the three well-pad point sources

*well-pad construction emissions rates released from each of the two well-pad volume sources

*southwest road improvement emissions rates released from each of the 15 volume sources allocated for this emissions group activity

*traffic related emissions rates released from each of the 151 volume sources allocated for this emissions group activity

Table 3b. HAPs Emissions Rates (grams / second) Modeled for Project Sources – Scenario 3

Emissions Source Activity	Formaldehyde	n-Hexane	Benzene	Ethyl-benzene	Toluene	Xylene
Drill Rigs	0.02542	NM	0.00196	0.00003	0.00069	0.00024
EcoNode Operation – LC24-6	0.35140	0.08216	0.01606	0.00027	0.00299	0.00130
EcoNode Operation – LC11-15	0.19766	0.04622	0.00903	0.00015	0.00168	0.00073
EcoNode Operation – LC11-13	0.14056	0.03287	0.00642	0.00011	0.00120	0.00052
EcoNode Operation – LC22	0.09497	0.02221	0.00434	0.00007	0.00081	0.00035

*NM = no emissions for this pollutant modeled for this emissions source activity

*drill rig engines emissions rates released from the one well-pad point source

The following plot shows the proposed project emissions source layout for Scenario 3. The layout is based on project proponent provided information for the proposed project. The closest sensitive receptors in the vicinity (few miles) of the proposed project and Pawnee National Grasslands surface areas are also shown in the plot.

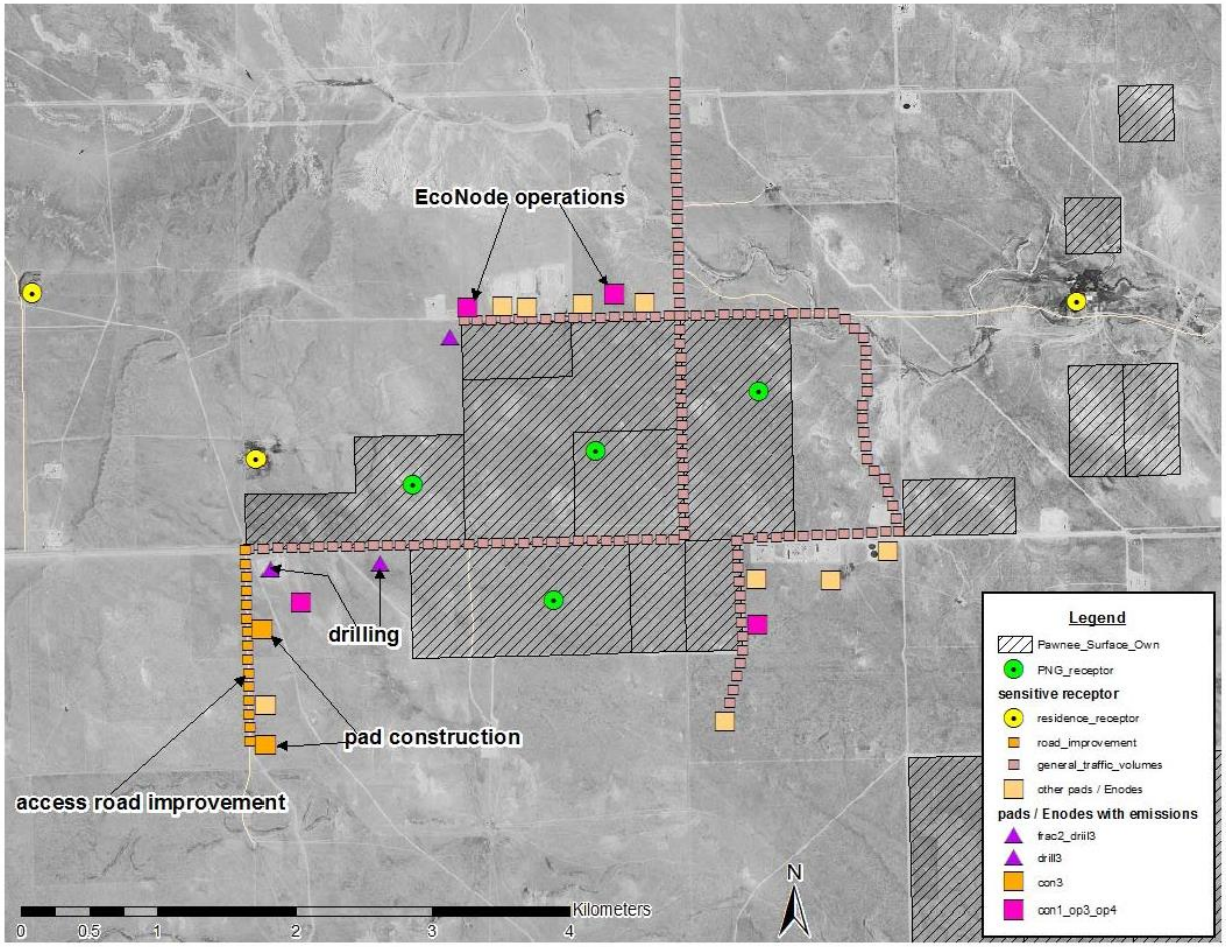


Figure 4. Proposed Project Emissions Source Layout - Scenario 3

Scenario 4 – Full Operations

For Scenario 4, there were four EcoNodes with 100% full operations: LC 11-15, LC 24-6, LC 11-13 and LC 22 and production related traffic. The EcoNode engines were modeled with point sources (one point source per EcoNode) and the production related traffic (151 volume source distributed over the entire network of proposed project roadways) activities were modeled using volume sources in AERMOD. The following table shows the emissions rates modeled for each point or volume source for each activity:

Table 4a. Criteria Pollutants Emissions Rates Modeled for Project Sources – Scenario 4

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
EcoNode Operations	4.03249	0.17770	0.17770
Road Traffic	0.00232	0.03353	0.00346

*EcoNode operations emissions rates released from each of the four EcoNode point sources

*traffic related emissions rates released from each of the 151 volume sources allocated for this emissions group activity

Table 4b. HAPs Emissions Rates (grams / second) Modeled for Project Sources – Scenario 4

Emissions Source Activity	Formaldehyde	n-Hexane	Benzene	Ethyl-benzene	Toluene	Xylene
EcoNode Operations	0.35140	0.08216	0.01606	0.00027	0.00299	0.00130

*EcoNode operations emissions rates released from each of the four EcoNode point sources

The following plot shows the proposed project emissions source layout for Scenario 4. The layout is based on project proponent provided information for the proposed project. The closest sensitive receptors in the vicinity (few miles) of the proposed project and Pawnee National Grasslands surface areas are also shown in the plot.

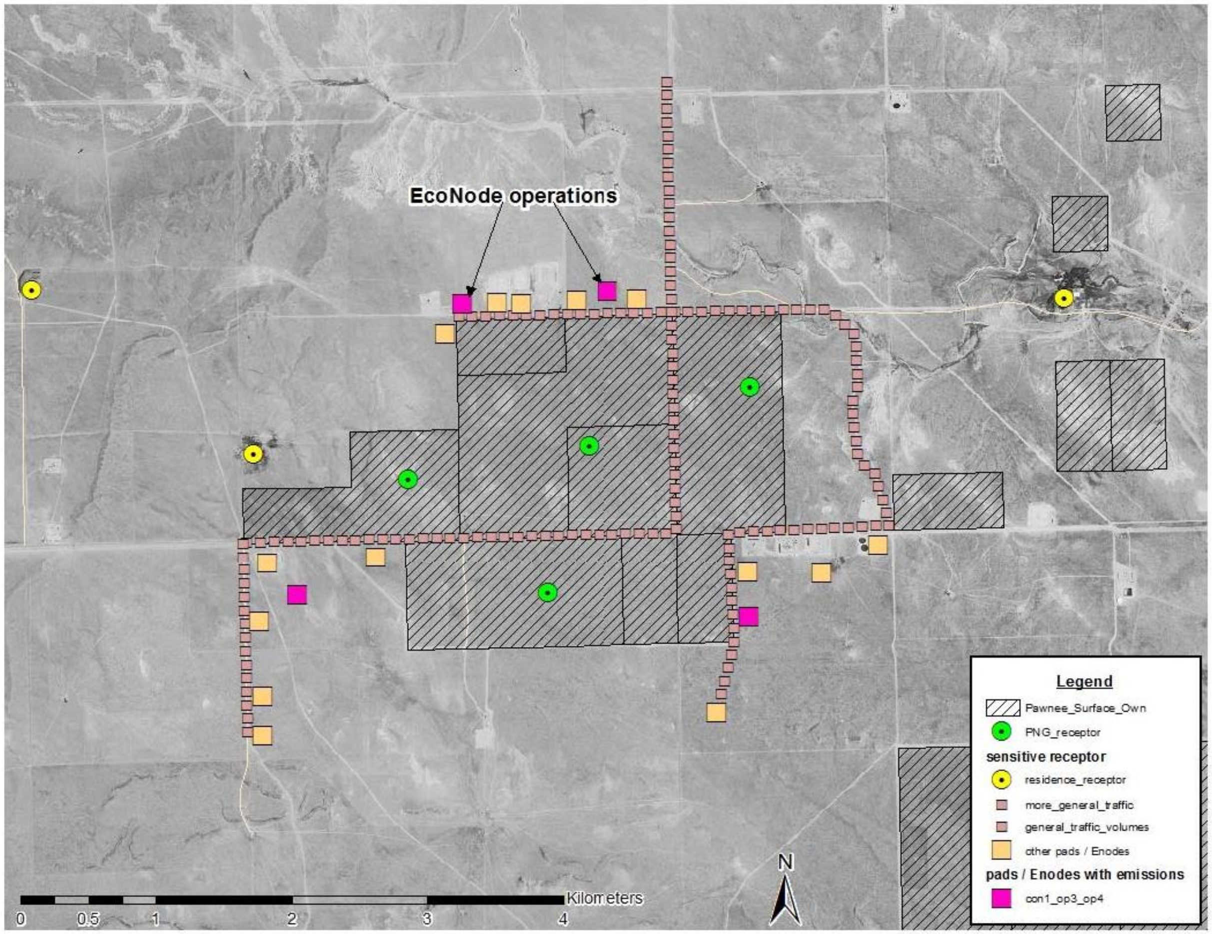


Figure 5. Proposed Project Emissions Source Layout - Scenario 4

More Information Regarding Emissions Source Setup for the Proposed Project

The following provides more details about the proposed project-related emissions sources that were included in the near-field modeling and any additional information about how the emissions were calculated or released / modeled within the near-field modeling domain:

- Well-pad drill rig or completion engine emissions were modeled from point sources with stack height: 6.2 meters, exhaust temperature: 675 K, exit velocity: 30 meters/second and stack tip diameter: 0.2 meters.
- Well-pad or EcoNode construction activities (surface disturbance and equipment) were modeled from volume sources with a release height: 2.29 meters, sigma-y: 1.42 meters and sigma-z: 2.13 meters.
- Roadway segment improvement / construction activities (surface disturbance and equipment) and traffic were modeled from volume sources with a release height: 1.52 meters, sigma-y: 0.71 meters and sigma-z: 1.42 meters.
- EcoNode engine emissions were modeled from point sources with stack height: 6.5 meters, exhaust temperature: 806.5 K, exit velocity: 46.4 meters/second and stack tip diameter: 0.3 meters.
- Project specific design features (standard operations / practices) as emissions controls accounted for in the modeling analysis: 50% dust control for construction phase surface disturbance and traffic, and LNG/NG fired drill rig and frac pump engines.
- Using a detailed diagram of the EcoNode engines layout and associated structure dimensions (provided by the project proponent), EPA's Building Profile Input Program for PRIME (BPIPPRM) calculated structure parameter values for modeling the EcoNode engines with downwash in AERMOD. The dominant downwash influencing structures for the EcoNode engines are the engine coolers with the following dimensions: 6.8 meters (length) by 2 meters (width) by 4.1 meters (height).
- The AERMOD Ozone Limiting Method (OLM) was used to convert ambient NOx (emitted from emissions sources modeled) to NO_2. A value of 20 percent (0.2) was used for all emissions source in-stack NO_2 concentration estimates and is a conservative in-stack ratio supported by data from EPA's NO_2/NO_x In-Stack Ratio (ISR) Database (EPA 2013) and data provided from oil and gas operators.
- The AERMOD wet and dry particle plume depletion algorithms were used in the model to account for particulate matter (PM_{10} and $PM_{2.5}$) settling / deposition due to precipitation, and gravitational and dynamic forces.

Nearby Existing Emissions Sources and Background Concentrations

An existing nearby emissions inventory was included in the cumulative near-field analysis (explicitly modeled in AERMOD) to account for steep air quality concentration gradients that can occur in the near-field vicinity of emissions sources. Monitored concentrations are used to represent all emissions sources impacts not explicitly modeled using AERMOD and were added to the near-field modeled concentrations (proposed project and nearby existing sources) to produce cumulative predicted near-field concentrations at ambient receptors for comparison to applicable air quality impact thresholds.

Nearby Existing Emissions Sources

In addition to the proposed Project sources, an inventory was developed for existing nearby emissions sources to include in the cumulative near-field impacts analysis. CDPHE provided criteria (including NO_2 and PM) and HAPs emissions inventories for current permitted northeast Colorado oil and gas operations were compiled and processed, and nearby existing emissions sources within 12 kilometers of the proposed project area were included in the cumulative AERMOD runs. Figure 1 shows locations of nearby existing emissions sources included in the cumulative near-field modeling analysis.

A total of 23 oil and gas existing nearby NO_2 emissions sources made up of engines, flares and heaters (modeled using point sources) were included in the cumulative AERMOD runs. Annual NO_2 emissions for these facilities totaled approximately 250 TPY. The Noble Energy Lilli Gas Processing Plant and Timbro LC13 EcoNode, Sterling Energy Grover Compressor Station and Whiting O&G Redtail Plant and Razor 21 Battery were among the facilities included in the cumulative near-field modeling analysis NO_2 inventory.

For PM ($PM_{2.5}$ and PM_{10}), 15 point sources made up of engines and heaters and one volume source (haul roads) were modeled in the cumulative near-field analysis for existing nearby emissions sources. The total annual PM_{10} and $PM_{2.5}$ emissions that were modeled for these sources were ~ 20.5 TPY and 16.2 TPY, respectively. The Noble Energy Timbro LC13 EcoNode, Sterling Energy Grover Compressor Station and Whiting O&G Redtail Plant and Razor 21 Battery were among the facilities included in the cumulative near-field modeling analysis PM inventory.

A total of 69 oil and gas existing nearby HAPs emissions sources consisting of engines, storage tanks and flares were included in the cumulative HAPs AERMOD runs. The total annual benzene, formaldehyde and n-hexane emissions that were modeled for these sources were ~ 22.8 TPY, 19.5 TPY and 97 TPY, respectively.

Ambient Background Concentrations

HAPs concentration data collected at a regional monitoring site and provided in the EPA Air Quality System (AQS) database (EPA 2015) are used for HAPs ambient background monitored concentrations for this cumulative near-field air quality modeling analysis. The regional monitoring site for HAPs is located in a Colorado-based high oil and gas development area similar to that of the proposed project location.

Projected year 2021 Colorado Air Resource Management Modeling Study (CARMMS [BLM 2015]) NO_2 and PM concentrations for a set of 4 kilometer resolution CARMMS grid cells points (26 points spaced at 4 kilometers apart) that intersect the near-field modeling domain were used to develop projected year NO_2 and PM "background" concentrations. These CARMMS projected year 2021 modeled concentrations are for the CARMMS total year 2021 cumulative emissions inventory (i.e. not just for a particular BLM planning area, source apportionment area or emissions source group for modeling) and represent projected concentrations for all emissions sources including mobile source, biogenic / natural, oil and gas, EGUs, farming and fires. The cumulative year 2021 emissions inventory for CARMMS was developed using the EPA's year

2020 emissions inventory for $PM_{2.5}$ NAAQS analysis with Three-State Air Quality Study (3SAQS) year 2020 updates and the BLM Colorado's year 2021 oil and gas projections. As described above in the previous sub-section (Nearby Existing Emissions Sources), the existing nearby oil and gas emissions source inventory annual emissions totals for NO_2, $PM_{2.5}$ and PM_{10} were approximately 250 TPY, 16.2 TPY and 20.5 TPY, respectively. The CARMMS year 2021 cumulative (all sources – not just oil and gas) NO_2, $PM_{2.5}$ and PM_{10} annual emissions totals for the 26 grid points (intersecting the near-field modeling domain) are 555 TPY, 78.5 TPY and 632.5 TPY, respectively. For the intersecting grid cells, the percentages of total CARMMS year 2021 NO_2, $PM_{2.5}$ and PM_{10} emissions associated with oil and gas sources are 94%, 74% and 74%, respectively. As shown, the CARMMS projected year 2021 modeled emissions rates for sources within the near-field modeling domain are much larger than the current year emissions rates and account for oil and gas growth in the project area as well as for non-oil and gas sources that are not explicitly modeled in the AERMOD runs for nearby existing source inventory (only oil and gas for nearby existing source inventory). The projected year 2021 CARMMS concentrations also account for future year emissions reductions for mobile sources and EGUs to provide a more look at realistic future concentrations than current baseline conditions. As described earlier, year 2021 CARMMS modeled concentrations are added to AERMOD modeled concentrations to determine cumulative air quality concentrations. Note that there would be some double-counting of the total cumulative air quality impacts associated with existing oil and gas sources since some of the emissions for these sources would be accounted for in both sets (explicitly modeled with AERMOD and in CARMMS) of values being added together.

The following Table 5 shows HAP concentrations for the regional monitor and CARMMS predicted year 2021 concentrations that are used to represent all emissions sources impacts not explicitly modeled using AERMOD. Pollutant concentrations are in units micrograms per cubic meter ($\mu g/m^3$) for all pollutants.

Table 5. Ambient Background Concentrations

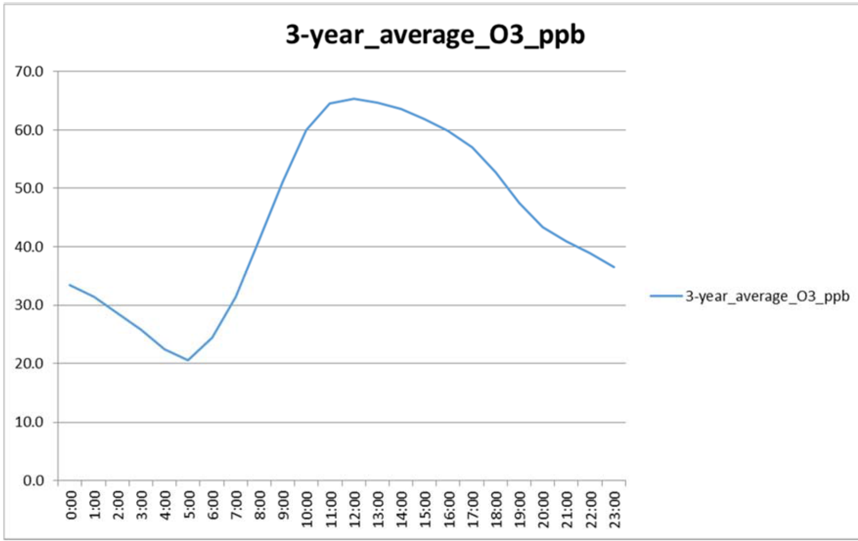
Pollutant / Units	Background Monitored Concentrations		Monitoring Station Information
	1-Hour / 24-Hour *	Annual Average *	
Benzene ($\mu g/m^3$)	28.75	9.11	Garfield County, Colorado (Rifle, Colorado). Monitor ID: 08-045-0007. 1-hour value is maximum for all reported concentrations in year 2013 dataset. Annual average value is average of all values in the year 2013 dataset.
Formaldehyde ($\mu g/m^3$)	4.37	1.38	

Pollutant / Units	Background Monitored Concentrations		Monitoring Station Information
	1-Hour / 24-Hour *	Annual Average *	
n-Hexane ($\mu g/m^3$)	80.01	20.46	
NO_2 ($\mu g/m^3$)	74.52	NA	Background concentration is 8th high daily 1-hour median value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).
PM_{10} ($\mu g/m^3$)	31.47	NA	Background concentration is 2nd high 24-hour average median value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).
$PM_{2.5}$ ($\mu g/m^3$)	11.41	5.49	Background concentrations are the 8th high 24-hour and annual average median values for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).

*$\mu g/m^3$ = micrograms per cubic meter
* NA ~ averaging time was not modeled for this assessment
*1-hour concentrations shown for all pollutants except PM species which are 24-hour average values

Background Concentrations for OLM

The OLM is an EPA Tier 3 modeling method that uses ozone concentrations to convert NO_X to NO_2. Three years (2011, 2012 and 2013) of monitored hourly ozone concentration data for Weld County, Colorado (Greeley) was obtained from EPA AQS (EPA 2015) and processed to generate seasonal-hourly ozone profile information for executing the OLM in AERMOD. The following chart shows three year average daily ozone profile for summer months that was used to convert NO_X to NO_2 using OLM for this modeling assessment.



NEAR-FIELD ASSESSMENT OF AIR QUALITY IMPACTS – CRITERIA POLLUTANTS

Sub-sections with maximum scenario specific modeling results are presented first followed by a sub-section with multi-year / scenario average modeled concentrations that are more realistic results for comparison to ambient air quality standards / thresholds for NO_2 1-hour and $PM_{2.5}$.

NO_2 and PM Impacts – Scenario 1

The following Table 6 shows results for near-field cumulative NO_2 and PM impacts analysis for Scenario 1. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds.

Table 6. NO_2 and PM Impacts – Scenario 1

Criteria Pollutant	Avg. Period	Year	Concentration (ug/m^3)			Ambient Standard (ug/m^3)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	Maximum Value for All Years	86.30	74.52	**160.81**	189	NA	85%
PM_{10}	24-hour	Maximum Value for All Years	37.08	31.47	**68.55**	150	150	46%
$PM_{2.5}$	24-hour	Maximum Value for All Years	4.24	11.41	**15.65**	35	NA	45%
$PM_{2.5}$	Annual	Maximum Value for All Years	1.28	5.49	**6.77**	12	NA	56%

CAAQS = Colorado Ambient Air Quality Standards
$\mu g/m^3$ = micrograms per cubic meter
NAAQS = National Ambient Air Quality Standards
* Due to 1-hour NO_2, 24-hour and annual $PM_{2.5}$ NAAQS format that uses a three-year average to determine compliance, only one total concentration is reported for the five-year modeling period.

The concentration values shown in the Table above are the maximum concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts. For all pollutants and averaging times, the overall maximum modeled concentrations (shown in Table) occur at PNG receptors and maximum modeled concentrations for residence receptors are lower especially for PM related impacts.

NO_2 and PM Impacts – Scenario 2

The following Table 7 shows results for near-field cumulative NO_2 and PM impacts analysis for Scenario 2. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds.

Table 7. NO_2 and PM Impacts – Scenario 2

Criteria Pollutant	Avg. Period	Year	Concentration (ug/m³)			Ambient Standard (ug/m³)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	Maximum Value for All Years	79.87	74.52	**154.39**	189	NA	82%
PM_{10}	24-hour	Maximum Value for All Years	16.40	31.47	**47.88**	150	150	32%
$PM_{2.5}$	24-hour	Maximum Value for All Years	1.67	11.41	**13.08**	35	NA	37%
$PM_{2.5}$	Annual	Maximum Value for All Years	0.55	5.49	**6.04**	12	NA	50%

CAAQS = Colorado Ambient Air Quality Standards
$\mu g/m^3$ = micrograms per cubic meter
NAAQS = National Ambient Air Quality Standards
* Due to 1-hour NO_2, 24-hour and annual $PM_{2.5}$ NAAQS format that uses a three-year average to determine compliance, only one total concentration is reported for the five-year modeling period.

The concentration values shown in the Table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts. For PM, the overall maximum modeled concentrations (shown in Table) occur at PNG receptors and the maximum modeled PM concentrations for residence receptors are much lower. The overall maximum modeled NO_2 concentration for this scenario (shown in Table) occurs at a residence receptor.

NO_2 and PM Impacts – Scenario 3

The following Table 8 shows results for near-field cumulative NO_2 and PM impacts analysis for Scenario 3. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds for PM and slightly above NAAQS for NO_2 1-hour. As described earlier in this report, Scenario 3 includes both a high level of construction / development and production related activities occurring at the same time. The NO_2 1-hour

NAAQS is calculated as a three-year average concentration and the value shown in Table 8 below would not occur for three consecutive years based on the project proponent's detailed development / production schedule. Three-year average modeling results that are more realistic for comparison to the NAAQS are presented following the scenario specific modeling results.

Table 8. NO_2 and PM Impacts – Scenario 3

Criteria Pollutant	Avg. Period	Year	Concentration (ug/m^3)			Ambient Standard (ug/m^3)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	Maximum Value for All Years	116.25	74.52	**190.77**	189	NA	101%
PM_{10}	24-hour	Maximum Value for All Years	58.54	31.47	**90.02**	150	150	60%
$PM_{2.5}$	24-hour	Maximum Value for All Years	5.84	11.41	**17.26**	35	NA	49%
$PM_{2.5}$	Annual	Maximum Value for All Years	1.81	5.49	**7.29**	12	NA	61%

CAAQS = Colorado Ambient Air Quality Standards

$\mu g/m^3$ = micrograms per cubic meter

NAAQS = National Ambient Air Quality Standards

* Due to 1-hour NO_2, 24-hour and annual $PM_{2.5}$ NAAQS format that uses a three-year average to determine compliance, only one total concentration is reported for the five-year modeling period.

In addition to the information above regarding the NO_2 1-hour modeled concentration for Scenario 3, the AERMOD modeled concentration represents emissions sources that are also accounted for in the CARMMS year 2021 background concentration. It would be reasonable to assume that removal of some of the future year emissions sources from the AERMOD or CARMMS run (i.e. eliminate double-counting) would result in a cumulative NO_2 1-hour modeled concentrations below the NAAQS for Scenario 3.

The concentration values shown in the Table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts. For PM, the overall maximum modeled concentrations (shown in Table) occur at PNG receptors and the maximum modeled PM concentrations for residence receptors are much lower. The overall maximum modeled NO_2 concentration for this scenario (shown in Table) occurs at a residence receptor.

NO_2 and PM Impacts – Scenario 4

The following Table 9 shows results for near-field cumulative NO_2 and PM impacts analysis for Scenario 4. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds.

Table 9. NO_2 and PM Impacts – Scenario 4

Criteria Pollutant	Avg. Period	Year	Concentration (ug/m^3)			Ambient Standard (ug/m^3)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	Maximum Value for All Years	92.18	74.52	**166.70**	189	NA	88%
PM_{10}	24-hour	Maximum Value for All Years	46.40	31.47	**77.88**	150	150	52%
$PM_{2.5}$	24-hour	Maximum Value for All Years	4.44	11.41	**15.85**	35	NA	45%
$PM_{2.5}$	Annual	Maximum Value for All Years	1.45	5.49	**6.93**	12	NA	58%

CAAQS = Colorado Ambient Air Quality Standards

$\mu g/m^3$ = micrograms per cubic meter

NAAQS = National Ambient Air Quality Standards

* Due to 1-hour NO_2, 24-hour and annual $PM_{2.5}$ NAAQS format that uses a three-year average to determine compliance, only one total concentration is reported for the five-year modeling period.

The concentration values shown in the Table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts. For PM, the overall maximum modeled concentrations (shown in Table) occur at PNG receptors and the maximum modeled PM concentrations for residence receptors are much lower. The overall maximum modeled NO_2 concentration for this scenario (shown in Table) occurs at a residence receptor.

NO_2 and $PM_{2.5}$ Impacts – Combined Scenario Average – NAAQS Analysis

The following Table 10 shows results for the combined scenario near-field cumulative NO_2 and $PM_{2.5}$ impacts analysis. NO_2 1-hour and $PM_{2.5}$ NAAQS are calculated using three years of monitored / modeled concentrations to develop three year averages. The combined scenario takes into consideration the detailed temporal schedule for construction / development and production activities and averages data for multiple scenarios to give more realistic predicted concentrations for comparisons to the NAAQS. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds.

Table 10. NO_2 and $PM_{2.5}$ Impacts – Combined Scenario Results

Criteria Pollutant	Avg. Period	Year	Concentration (ug/m^3)			Ambient Standard (ug/m^3)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	Mutiple Scenario Average	86.62	74.52	**161.14**	189	NA	85%
$PM_{2.5}$	24-hour	Mutiple Scenario Average	4.84	11.41	**16.25**	35	NA	46%
$PM_{2.5}$	Annual	Mutiple Scenario Average	1.51	5.49	**7.00**	12	NA	58%

CAAQS = Colorado Ambient Air Quality Standards
$\mu g/m^3$ = micrograms per cubic meter
NAAQS = National Ambient Air Quality Standards
* Due to 1-hour NO_2, 24-hour and annual $PM_{2.5}$ NAAQS format that uses a three-year average to determine compliance, only one total concentration is reported for the five-year modeling period.

The maximum 5-year concentration for Scenario 1 and 2 (max of these two scenarios) is added to the maximum 5-year concentration for Scenario 3 and the maximum 5-year concentration for Scenario 4 and average of these three values is shown in the table above for each pollutant / averaging times. For PM, the overall maximum modeled concentrations (shown in Table) occur at PNG receptors and the maximum modeled PM concentrations for residence receptors are much lower. The overall maximum modeled NO_2 concentration for this combined scenario analysis (shown in table) occurs at a residence receptor.

NEAR-FIELD ASSESSMENT OF AIR QUALITY IMPACTS – HAZARDOUS AIR POLLUTANTS

Short-term (1-hour) HAP concentrations are compared to acute Reference Exposure Levels (RELs). RELs are defined as concentrations at or below which no adverse health effects are expected. No REL is available for n-hexane; instead, the available Immediately Dangerous to Life or Health divided by 10 (IDLH/10) values are used. These IDLH values were determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from USEPA's Air Toxics Database (EPA 2011). These values approximate pollutant concentrations likely to produce mild effects during 1-hour exposures.

Long-term maximum potential exposures to HAPs are compared to Reference Concentrations for Chronic Inhalation (RfCs). An RfC is defined by USEPA as the daily inhalation concentration at which no long-term adverse health effects are expected. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (EPA, 2012). Annual modeled HAP concentrations for each modeled HAP were compared directly to the non-carcinogenic RfCs.

Of the above HAPs, only benzene and formaldehyde are suspected to be carcinogenic. RfCs for these HAPs are expressed as unit risk factors (URFs). Accepted methods for risk assessment were used to evaluate the incremental cancer risk for these pollutants. Based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan, a cancer risk range of 1 in a million to 100 in a million (10^{-6} to 10^{-4} risk) is generally acceptable (EPA 1990). Cancer risks are calculated for each individual HAP and for combined exposure to aggregated HAPs for both the maximally exposed individual (MEI) and most likely exposure (MLE). A detailed explanation of this determination is provided below.

Annual total concentrations (modeled plus background) were multiplied by USEPA's URF (based on 70-year exposure) for those pollutants, and then the product was multiplied by an adjustment factor that represents the ratio of projected exposure time to 70 years. The adjustment factors represent two scenarios: a MLE scenario and one reflective of the MEI.

The MLE duration was assumed to be 9 years, which corresponds to the mean duration that a family remains at a residence (EPA 1993). This duration corresponds to an adjustment factor of 9/70 = 0.13. The duration of exposure for the MEI was assumed to be 20 years (i.e., the LOP), corresponding to an adjustment factor of 20/70 = 0.29.

A second adjustment was made for time spent at home versus time spent elsewhere. For the MLE scenario, the at-home time fraction is 0.64 (EPA 1993), and it was assumed that during the rest of the day the individual would remain in an area where annual HAP concentrations would be one-quarter as large as the maximum annual average concentration. Therefore, the MLE adjustment factor was $(0.13) \times [(0.64 \times 1.0) + (0.36 \times 0.25)] = 0.095$. The MEI scenario assumed that the individual is at home 100 percent of the time, for a final adjustment factor of $(0.29 \times 1.0) = 0.29$.

HAPs Impacts – Scenario 1

As shown in the following Table 11, all HAP maximum 1-hour concentrations (including background concentrations) are well below the REL or IDLH/10 reference concentrations.

Table 11. Acute HAPs Impacts – Scenario 1

HAP	Modeled Year	Maximum 1-Hour Modeled ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	REL ($\mu g/m^3$)	Percent of REL (%)
Benzene	Maximum Value for All Years	7.09	28.75	**35.84**	1,300	3%
Ethylbenzene	Maximum Value for All Years	0.61	NA	**0.61**	350,000	0%
Formaldehyde	Maximum Value for All Years	2.66	4.37	**7.03**	55	13%
n-Hexane	Maximum Value for All Years	NA	80.01	**80.01**	390,000	0%
Toluene	Maximum Value for All Years	7.83	NA	**7.83**	37,000	0%
Xylene	Maximum Value for All Years	2.85	NA	**2.85**	22,000	0%

$\mu g/m^3$ = micrograms per cubic meter

REL = Reference Exposure Level

* data source for all pollutants except n-hexane: USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

*No REL available for n-hexane. Values shown are from Immediately Dangerous to Life or Health (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

The concentration values shown in the Table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

As shown in the following table, the maximum annual modeled HAPs concentrations for all receptors are well below their respective RfCs.

Table 12. Chronic HAPs Impacts – Scenario 1

Pollutant	Year	Annual Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	RfC ($\mu g/m^3$)
Benzene	Maximum Value for All Years	0.09	9.11	**9.21**	30
Ethylbenzene	Maximum Value for All Years	0.01	NA	**0.01**	1,000
Formaldehyde	Maximum Value for All Years	0.09	1.38	**1.47**	9.8
n-Hexane	Maximum Value for All Years	NA	20.46	**20.46**	200
Toluene	Maximum Value for All Years	0.06	NA	**0.06**	400
Xylene	Maximum Value for All Years	0.02	NA	**0.02**	100

$\mu g/m^3$ = micrograms per cubic meter

RfC = Reference Concentration for Chronic Inhalation

* USEPA Air Toxics Database, Table 1 (USEPA, 2005b).

The concentration values shown in the Table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

Cancer risk from benzene, formaldehyde, and the combined HAPs (benzene plus formaldehyde) are shown in Table 13. For the MLE, an individual could encounter a maximum cancer risk due to benzene of up to ~ 7 in one million. The MLE risk due to formaldehyde is ~ 2 in a million. The combined HAPs MLE risk is approximately 9 in one million. Cancer risks are greater for an MEI, with a risk of up to ~ 21 (in one million) due to benzene exposure and up to 6 (in one million) for formaldehyde exposure.

Table 13. Long-Term Cancer Risk – Scenario 1

HAP	Year	Analysis	Carcinogenic RfC URF 1/(μg/m^3)	Exposure Adj. Factor	Cancer Risk (per million)
Benzene	Maximum Value for All Years	MLE	7.8×10^{-6}	0.095	6.82E-06
		MEI	7.8×10^{-6}	0.29	2.08E-05
Formaldehyde	Maximum Value for All Years	MLE	1.3×10^{-5}	0.095	1.82E-06
		MEI	1.3×10^{-5}	0.29	5.54E-06
Total Combined		**MLE**			**8.64E-06**
		MEI			**2.64E-05**

MEI = maximally exposed individual
μg/m^3 = micrograms per cubic meter
MLE = most likely exposure
URF = unit risk factor
* USEPA Air Toxics Database, Table 1 (EPA 2012).

HAPs Impacts – Scenario 2

As shown in the following Table 14, all HAP maximum 1-hour concentrations (including background concentrations) are well below the REL or IDLH/10 reference concentrations.

Table 14. Acute HAPs Impacts – Scenario 2

HAP	Modeled Year	Maximum 1-Hour Modeled ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	REL ($\mu g/m^3$)	Percent of REL (%)
Benzene	Maximum Value for All Years	7.09	28.75	**35.84**	1,300	3%
Ethylbenzene	Maximum Value for All Years	0.61	NA	**0.61**	350,000	0%
Formaldehyde	Maximum Value for All Years	6.95	4.37	**11.32**	55	21%
n-Hexane	Maximum Value for All Years	NA	80.01	**80.01**	390,000	0%
Toluene	Maximum Value for All Years	7.83	NA	**7.83**	37,000	0%
Xylene	Maximum Value for All Years	2.85	NA	**2.85**	22,000	0%

$\mu g/m^3$ = micrograms per cubic meter

REL = Reference Exposure Level

* data source for all pollutants except n-hexane: USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

* No REL available for n-hexane. Values shown are from Immediately Dangerous to Life or Health (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

The following table shows that the maximum annual modeled HAPs concentrations for all receptors are well below their respective RfCs for scenario 2.

Table 15. Chronic HAPs Impacts – Scenario 2

Pollutant	Year	Annual Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	RfC ($\mu g/m^3$)
Benzene	Maximum Value for All Years	0.09	9.11	**9.21**	30
Ethylbenzene	Maximum Value for All Years	0.01	NA	**0.01**	1,000
Formaldehyde	Maximum Value for All Years	0.14	1.38	**1.52**	9.8
n-Hexane	Maximum Value for All Years	NA	20.46	**20.46**	200
Toluene	Maximum Value for All Years	0.06	NA	**0.06**	400
Xylene	Maximum Value for All Years	0.02	NA	**0.02**	100

$\mu g/m^3$ = micrograms per cubic meter

RfC = Reference Concentration for Chronic Inhalation

* USEPA Air Toxics Database, Table 1 (USEPA, 2005b).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

Cancer risk from benzene, formaldehyde, and the combined HAPs (benzene plus formaldehyde) are shown in Table 16. For the MLE, an individual could encounter a maximum cancer risk due to benzene of up to ~ 7 in one million. The MLE risk due to formaldehyde is ~ 2 in a million. The combined HAPs MLE risk is approximately 9 in one million. Cancer risks are greater for an MEI, with a risk of up to ~ 21 (in one million) due to benzene exposure and up to 6 (in one million) for formaldehyde exposure.

Table 16. Long-Term Cancer Risk – Scenario 2

HAP	Year	Analysis	Carcinogenic RfC URF 1/($\mu g/m^3$)	Exposure Adj. Factor	Cancer Risk (per million)
Benzene	Maximum Value for All Years	MLE	7.8×10^{-6}	0.095	6.82E-06
		MEI	7.8×10^{-6}	0.29	2.08E-05
Formaldehyde	Maximum Value for All Years	MLE	1.3×10^{-5}	0.095	1.88E-06
		MEI	1.3×10^{-5}	0.29	5.74E-06
Total Combined		**MLE**			**8.70E-06**
		MEI			**2.66E-05**

MEI = maximally exposed individual
$\mu g/m^3$ = micrograms per cubic meter
MLE = most likely exposure
URF = unit risk factor
* USEPA Air Toxics Database, Table 1 (EPA 2012).

HAPs Impacts – Scenario 3

As shown in the following Table 17, all HAP maximum 1-hour concentrations (including background concentrations) are well below the REL or IDLH/10 reference concentrations.

Table 17. Acute HAPs Impacts – Scenario 3

HAP	Modeled Year	Maximum 1-Hour Modeled ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	REL ($\mu g/m^3$)	Percent of REL (%)
Benzene	Maximum Value for All Years	7.09	28.75	**35.84**	1,300	3%
Ethylbenzene	Maximum Value for All Years	0.61	NA	**0.61**	350,000	0%
Formaldehyde	Maximum Value for All Years	9.26	4.37	**13.63**	55	25%
n-Hexane	Maximum Value for All Years	40.81	80.01	**120.82**	390,000	0%
Toluene	Maximum Value for All Years	7.83	NA	**7.83**	37,000	0%
Xylene	Maximum Value for All Years	2.85	NA	**2.85**	22,000	0%

$\mu g/m^3$ = micrograms per cubic meter

REL = Reference Exposure Level

* data source for all pollutants except n-hexane: USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

* No REL available for n-hexane. Values shown are from Immediately Dangerous to Life or Health (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

The following table shows that the maximum annual modeled HAPs concentrations for all receptors are well below their respective RfCs for scenario 3.

Table 18. Chronic HAPs Impacts – Scenario 3

Pollutant	Year	Annual Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	RfC ($\mu g/m^3$)
Benzene	Maximum Value for All Years	0.09	9.11	**9.21**	30
Ethylbenzene	Maximum Value for All Years	0.01	NA	**0.01**	1,000
Formaldehyde	Maximum Value for All Years	0.19	1.38	**1.58**	9.8
n-Hexane	Maximum Value for All Years	0.41	20.46	**20.87**	200
Toluene	Maximum Value for All Years	0.06	NA	**0.06**	400
Xylene	Maximum Value for All Years	0.02	NA	**0.02**	100

$\mu g/m^3$ = micrograms per cubic meter

RfC = Reference Concentration for Chronic Inhalation

* USEPA Air Toxics Database, Table 1 (USEPA, 2005b).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

Cancer risk from benzene, formaldehyde, and the combined HAPs (benzene plus formaldehyde) are shown in Table 19. For the MLE, an individual could encounter a maximum cancer risk due to benzene of up to ~ 7 in one million. The MLE risk due to formaldehyde is ~ 2 in a million. The combined HAPs MLE risk is approximately 9 in one million. Cancer risks are greater for an MEI, with a risk of up to ~ 21 (in one million) due to benzene exposure and up to 6 (in one million) for formaldehyde exposure.

Table 19. Long-Term Cancer Risk – Scenario 3

HAP	Year	Analysis	Carcinogenic RfC URF 1/(μg/m³)	Exposure Adj. Factor	Cancer Risk (per million)
Benzene	Maximum Value for All Years	MLE	7.8×10^{-6}	0.095	6.82E-06
		MEI	7.8×10^{-6}	0.29	2.08E-05
Formaldehyde	Maximum Value for All Years	MLE	1.3×10^{-5}	0.095	1.95E-06
		MEI	1.3×10^{-5}	0.29	5.94E-06
Total Combined		**MLE**			**8.77E-06**
		MEI			**2.68E-05**

MEI = maximally exposed individual
μg/m³ = micrograms per cubic meter
MLE = most likely exposure
URF = unit risk factor
* USEPA Air Toxics Database, Table 1 (EPA 2012).

HAPs Impacts – Scenario 4

As shown in the following Table 20, all HAP maximum 1-hour concentrations (including background concentrations) are well below the REL or IDLH/10 reference concentrations.

Table 20. Acute HAPs Impacts – Scenario 4

HAP	Modeled Year	Maximum 1-Hour Modeled ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	REL ($\mu g/m^3$)	Percent of REL (%)
Benzene	Maximum Value for All Years	7.09	28.75	**35.84**	1,300	3%
Ethylbenzene	Maximum Value for All Years	0.61	NA	**0.61**	350,000	0%
Formaldehyde	Maximum Value for All Years	16.00	4.37	**20.37**	55	37%
n-Hexane	Maximum Value for All Years	40.81	80.01	**120.82**	390,000	0%
Toluene	Maximum Value for All Years	7.83	NA	**7.83**	37,000	0%
Xylene	Maximum Value for All Years	2.85	NA	**2.85**	22,000	0%

$\mu g/m^3$ = micrograms per cubic meter

REL = Reference Exposure Level

* data source for all pollutants except n-hexane: USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

* No REL available for n-hexane. Values shown are from Immediately Dangerous to Life or Health (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

The following table shows that the maximum annual modeled HAPs concentrations for all receptors are well below their respective RfCs for scenario 4.

Table 21. Chronic HAPs Impacts – Scenario 4

Pollutant	Year	Annual Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Maximum Total Concentration (μg/m³)	RfC (μg/m³)
Benzene	Maximum Value for All Years	0.09	9.11	**9.21**	30
Ethylbenzene	Maximum Value for All Years	0.01	NA	**0.01**	1,000
Formaldehyde	Maximum Value for All Years	0.27	1.38	**1.65**	9.8
n-Hexane	Maximum Value for All Years	0.41	20.46	**20.87**	200
Toluene	Maximum Value for All Years	0.06	NA	**0.06**	400
Xylene	Maximum Value for All Years	0.02	NA	**0.02**	100

μg/m³ = micrograms per cubic meter
RfC = Reference Concentration for Chronic Inhalation
* USEPA Air Toxics Database, Table 1 (USEPA, 2005b).

The concentration values shown in the table above are the maximum modeled concentrations for all receptors for all five years of meteorology that was used for modeling maximum impacts.

Cancer risk from benzene, formaldehyde, and the combined HAPs (benzene plus formaldehyde) are shown in Table 19. For the MLE, an individual could encounter a maximum cancer risk due to benzene of up to ~ 7 in one million. The MLE risk due to formaldehyde is ~ 2 in a million. The combined HAPs MLE risk is approximately 9 in one million. Cancer risks are greater for an MEI, with a risk of up to ~ 21 (in one million) due to benzene exposure and up to 6 (in one million) for formaldehyde exposure.

Table 22. Long-Term Cancer Risk – Scenario 4

HAP	Year	Analysis	Carcinogenic RfC URF 1/(μg/m^3)	Exposure Adj. Factor	Cancer Risk (per million)
Benzene	Maximum Value for All Years	MLE	7.8×10^{-6}	0.095	6.82E-06
		MEI	7.8×10^{-6}	0.29	2.08E-05
Formaldehyde	Maximum Value for All Years	MLE	1.3×10^{-5}	0.095	2.04E-06
		MEI	1.3×10^{-5}	0.29	6.21E-06
Total Combined		**MLE**			**8.86E-06**
		MEI			**2.70E-05**

MEI = maximally exposed individual
μg/m^3 = micrograms per cubic meter
MLE = most likely exposure
URF = unit risk factor
* USEPA Air Toxics Database, Table 1 (EPA 2012).

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APPENDIX C-3 AIR QUALITY

SUMMARY OF BLM CARMMS MODELING RESULTS FOR CUMULATIVE IMPACTS ASSESSMENT

The proposed action, when combined with the past, present, and reasonably foreseeable future actions may contribute incrementally to the deterioration of air quality in the region. Development of fluid minerals at the rate proposed within the region would result in additional surface and subsurface disturbances and emissions during construction, drilling, completion, and production activities. The severity of these incremental impacts could be elevated based on the amount of contemporaneous development (either federal or private) in surrounding areas.

In consideration of disclosing cumulative and regional air quality impacts, the BLM has initiated the Colorado Air Resources Management Modeling Study (CARMMS). The study includes assessing statewide impacts of projected oil and gas development (both federal and fee (i.e. private)) out to year 2021 for three development scenarios (low, medium, and high). Projections for development are based on either the most recent Field Office (FO) Reasonably Foreseeable Development (RFD) document (high), or by projecting the current 5-year average development paces forward to 2021 (low). The medium scenario included the same well count projections as the high, but assumed restricted emissions, where the high assumed current development practices and "on the books" emissions controls and regulations (2012). Each FO was modeled with the source apportionment option, meaning that incremental impacts to regional ozone and AQRVs from Federal oil and gas development in these areas are essentially tracked to better understand the significance of such development on impacted resources and populations. The CARMMS project leverages the work completed by the WestJumpAQMS, and the base model platform and model performance metrics are based on those products (2008).

Based on the CARMMS projections, the BLM continually tracks emissions changes and air quality conditions to determine which projection path (low , medium, high) would be most appropriate to estimate air quality impact correlations based on the cumulative development (i.e. net emissions changes) that has occurred since the base emissions inventory year (2008). Although the predicted impacts will be based on future modeling results (2021), the relative changes in the impacts between the scenarios will provide insight into in understanding how mass emissions impact the atmosphere on a relative basis.

For the CARMMS, the Royal Gorge Field Office (RGFO) region was broken into 4 geographic areas due to the overall size and diversity of the RGFO. Figure 3-1 shows the northern RGFO Area #1 for CARMMS and the proposed Project would be approximately in the middle of this CARMMS source apportionment area. In addition, the RGFO Area #1 is further broken into two source apportionment modeling areas for CARMMS: within Pawnee National Grasslands (PNG) boundary and outside PNG boundary. The proposed Project is located within the PNG boundary of RGFO Area #1.

CARMMS O&G Development and Emissions Tables

Table C-1 provides the RGFO Area # 1 oil and gas development and projected production rates modeled for the CARMMS RFD (High) and 5-year Average (Low) modeling scenarios (includes all development within PNG and outside PNG boundary).

Table C-1: CARMMS Future O&G Development / Projections Modeled – RGFO Area #1

Parameter	RFD (High) Scenario[1]	5-year Average (Low) Scenario[2]
Federal Wells Per Year	47 (470 in 10 years)	9 (100 in 10 years)
Cumulative (Fed and non-Fed) Wells Per Year	585	1,350
Wells Per Pad (assumed for analysis)	4	4
2021 Cumulative Active Well Counts	29,673	37,323
% 2021 Cumulative Wells that Are Federal	2%	1%
Cumulative Average Annual No. Drill Rigs Operating	32	74
Cumulative 2021 Gas Production (MMscf/yr)	514,165	800,374
Cumulative 2021 Oil / Condensate Production (Mbbl/yr)	163,744	341,476

[1] RFD based on O&G Industry and BLM Resource Specialists 20-year projections for the RGFO.
[1] Future O&G development projections based on recent 5 years (2008-2012) of O&G development data for the RGFO.

Table C-2 provides baseline year 2011 Federal oil and gas emissions and projected Federal oil and gas emissions growth starting year 2012 through year 2021 for the RGFO Area #1 within the PNG for the CARMMS High and Low Scenario. The CARMMS High and Low source apportionment modeled results for the PNG oil and gas development area are associated with the post-2012 Federal oil and gas emissions growth / modeled rates shown in the following table.

Table C-2: CARMMS Baseline Year 2011 and Total Projected Emissions Growth by Year 2021 (TPY) – RGFO Area #1 Federal O&G (inside PNG boundary)

Field Office	PM_{10}	$PM_{2.5}$	NO_X	VOC	SO_2
Baseline - 2011	11	4	140	666	1
RFD (High) Scenario – 2021 Modeled Rates	689	90	930	2,682	3
RFD (Low) Scenario – 2021 Modeled Rates	129	17	188	804	1

Annual oil and gas completions / development inventories (post year 2011) are routinely compiled by the BLM CO State Office to ensure that current and future oil and gas development does not exceed the acceptable "budgets" (O&G development / emissions rates) as modeled in CARMMS. As of January 1st, 2015, approximately 51 new Federal O&G wells have been completed for the entire RGFO (most wells are located in Area #1) since year 2011 (approximately 17 new Federal wells per year). This annual development rate is much lower than the ~ 47 new Federal wells per year for RGFO Area #1 as modeled for CARMMS year 2021 RFD scenario (new development for years 2012 through 2021) and is currently tracking closer to the ~ 9 new Federal wells per year (new O&G development for years 2012 through 2021) for RGFO Area #1 as modeled for the CARMMS "low" scenario.

As future oil and gas development occurs (including the proposed project) in the RGFO, project-specific emissions (based on approved APDs) are being added to the total regional emissions estimates (all emissions sources: oil and gas emissions and more) to compare regional emissions rates modeled in cumulative air quality modeling studies (CARMMS) along with the corresponding modeling results to confirm that activities approved by the BLM Colorado are within the modeled emissions analyzed in the cumulative analyses. The results and summaries of these annual analyses will be included in the BLM Colorado Air Resources annual reports (projected to begin year 2015 for calendar year 2014).

Based on the oil and gas development level analysis as described above and the information provided in Table 3-6, it is reasonable to conclude that current levels of RGFO Federal oil and gas development are tracking at (or near) CARMMS "low" levels. However, the modeling results for the CARMMS High scenario are being presented for assessing future potential regional/cumulative air quality impacts since RFD indicates that increased (more than current levels) annual Federal O&G development is likely to occur in RGFO Area #1, specifically the PNG area. The following sub-section provides CARMMS High scenario source apportionment modeling results for incremental RGFO Area #1 oil and gas development/growth year 2012 through year 2021 within PNG.

CARMMS Modeling Results for High Scenario – RGFO Area #1 Federal O&G

As described above, the RFD forward projections (High) modeling scenario provides a look at impacts that would cover all potential oil and gas development using BLM O&G specialists and industry O&G development projection data. Table C-3 provides a quasi-cumulative summary of ozone, visibility and nitrogen deposition impacts for all of the new (post-year 2011) projected RGFO Area #1 Federal oil and gas emissions within the PNG boundary (proposed Project is located within Pawnee National Grasslands boundary) associated with the High modeling scenario. These impacts show the relative contribution to full cumulative (all world-wide emissions sources) impacts for the new projected RGFO Area #1 oil and gas emissions (within Pawnee NG) associated with the High modeling scenario.

Table C-3: CARMMS – RGFO Area #1 Federal O&G Contribution to Modeled Impacts

Source Group - Modeling Scenario	Number of Annual Days Above 0.5 dv Change	Maximum Modeled Annual Nitrogen Deposition (kg/ha-yr)	Overall Maximum 4th High Daily 8-hour Ozone Contribution (ppb)	Maximum 4th High Daily 8-hour Ozone Contribution to Modeled Exceedance (ppb)	Overall Maximum 8th High 24-hour $PM_{2.5}$ Contribution (ug/m^3)
RGFO Area #1 within PNG – High Scenario - Year 2021	0	0.0017	0.5	0.03	0.6

* maximum modeled concentrations / values for any Class I / sensitive Class II area (AQRV) or grid cell (ozone).

As shown in the table above, there are no days that the projected new RGFO year 2021 Federal oil and gas emissions within PNG have a significant (~ 0.5 dv) visibility change impact at any Class I or sensitive Class II area and the maximum modeled nitrogen deposition contribution is below the Deposition

Analysis Threshold (DAT) ~ 0.005 kg/ha-yr and minimal with respect to the cumulative critical nitrogen deposition load of 2.3 kg/ha-yr value. The maximum contributions to 4th high daily maximum 8-hour ozone concentrations are minimal with respect to the 75 ppb 8-hour ozone standard and the maximum contribution to the 8th high maximum 24-hour $PM_{2.5}$ concentration is minimal with respect to the 35 ug/m^3 24-hour $PM_{2.5}$ standard.

The information above shows that the predicted air quality impact contributions associated with the CARMMS RFD High oil and gas development scenario for the RGFO Area #1 within PNG are minimal, and it is reasonable to conclude that project-level O&G development (based on actual development plans) would have even lower contributions to the overall cumulative air quality.

CARMMS Modeling Results – Full Cumulative

Even though current oil and gas development rates are tracking at or below CARMMS Low modeling scenario oil and gas development projections (new O&G development for years 2012 through 2021) for all or most of the BLM Colorado planning areas / Field Offices, the CARMMS High modeling scenario results are being reported for cumulative air quality impacts in order to be consistent with the CARMMS RGFO Area #1 – PNG specific impacts discussion. It's important to note that all other emissions sources (other than new Colorado –based O&G) were modeled at the same rates for the CARMMS High and Low scenarios (the new Colorado O&G were only source category with varying development / emissions rates for the different CARMMS modeling scenarios).

Table C-4 provides a full cumulative summary of ozone, visibility and nitrogen deposition impacts for all (i.e. world-wide) emissions sources associated with the CARMMS High modeling scenario.

Table C-4: CARMMS Modeled AQRV Impacts - High 2021 Scenario - Full Cumulative Emissions Inventory

Class I Area	Best 20% Days Visibility Metric (dv) - 2021 High Improvement from 2008	Worst 20% Days Visibility Metric (dv) - 2021 High Improvement from 2008	Maximum Modeled Annual Nitrogen Deposition (kg/ha-yr) – 2021 High Improvement from 2008
Rocky Mtn. National Park	0.04	0.89	1.08

* positive values mean overall improvement and deposition values are maximum for all grid cells making up the Class I area.

For full cumulative ozone design value projections at regional ozone monitoring sites, the maximum current year 8-hour ozone design concentration (DVC; based on 2006-2010 observations) is 82.0 ppb at the Rocky Flats North (CO_Jefferson_006) monitor that is projected to be reduced to 79.5 ppb for the CARMMS 2021 High Development Scenario. There are eight monitoring sites in the CARMMS 4 km domain with current year DVCs above the ozone NAAQS that are reduced to two sites in the 2021 High Scenario, Rocky Flats North and Fort Collins West (CO_Larimer_0011).

For the ozone design value projection unmonitored area analysis (analysis for areas with no monitors), the geographical extent (i.e. size) of the overall area of ozone design value exceedances is reduced (from 2008 to 2021). Figure C-1 shows predicted ozone reductions in the Denver and Salt Lake City areas for the CARMMS High development scenario. The plot does show a small area with design future ozone value increases in western portions of Weld and eastern potions of Larimer Counties.

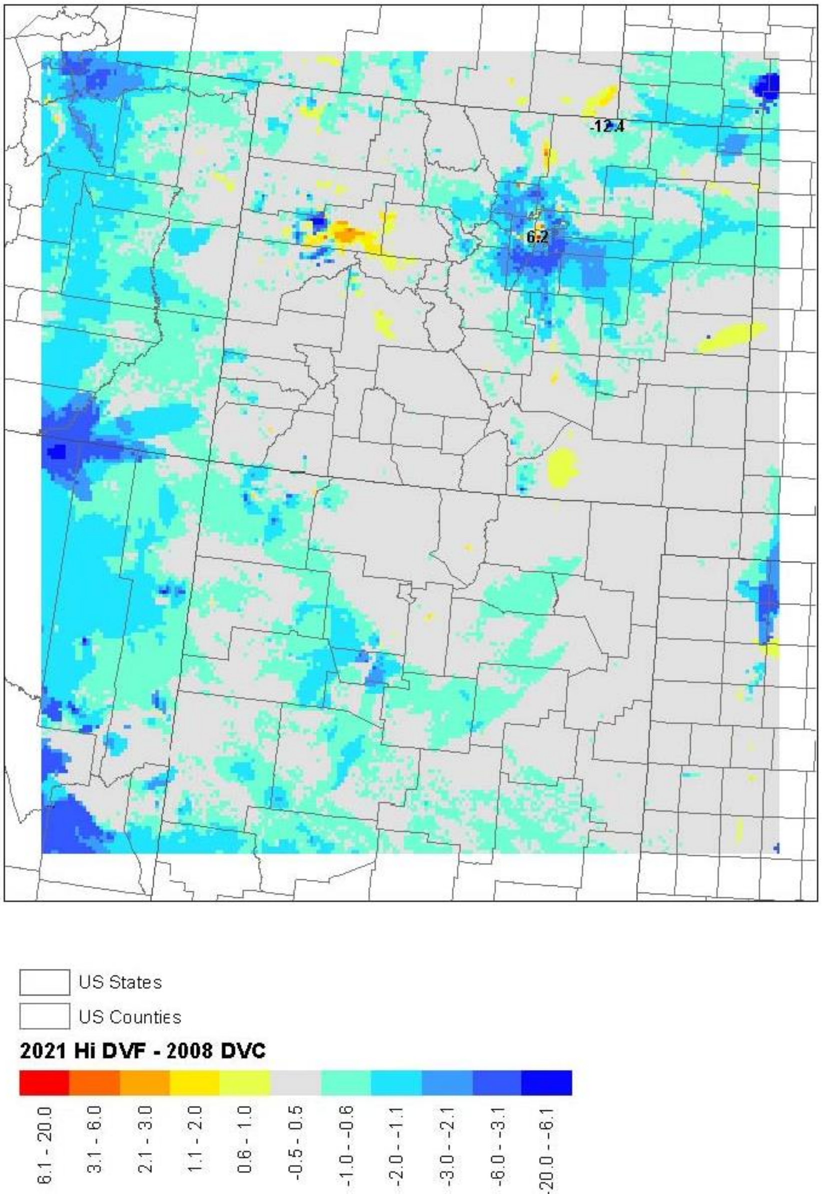

Figure C-1: Predicted Ozone Reductions in the Denver and Salt Lake City Areas for the CARMMS High Development Scenario

Figure C-2 shows changes in 8th highest daily average $PM_{2.5}$ concentrations (2021 High Scenario minus Base Year 2008 concentrations). As shown in the figure, concentrations are expected to increase in major Colorado Front Range cities and near mining operations in Colorado.

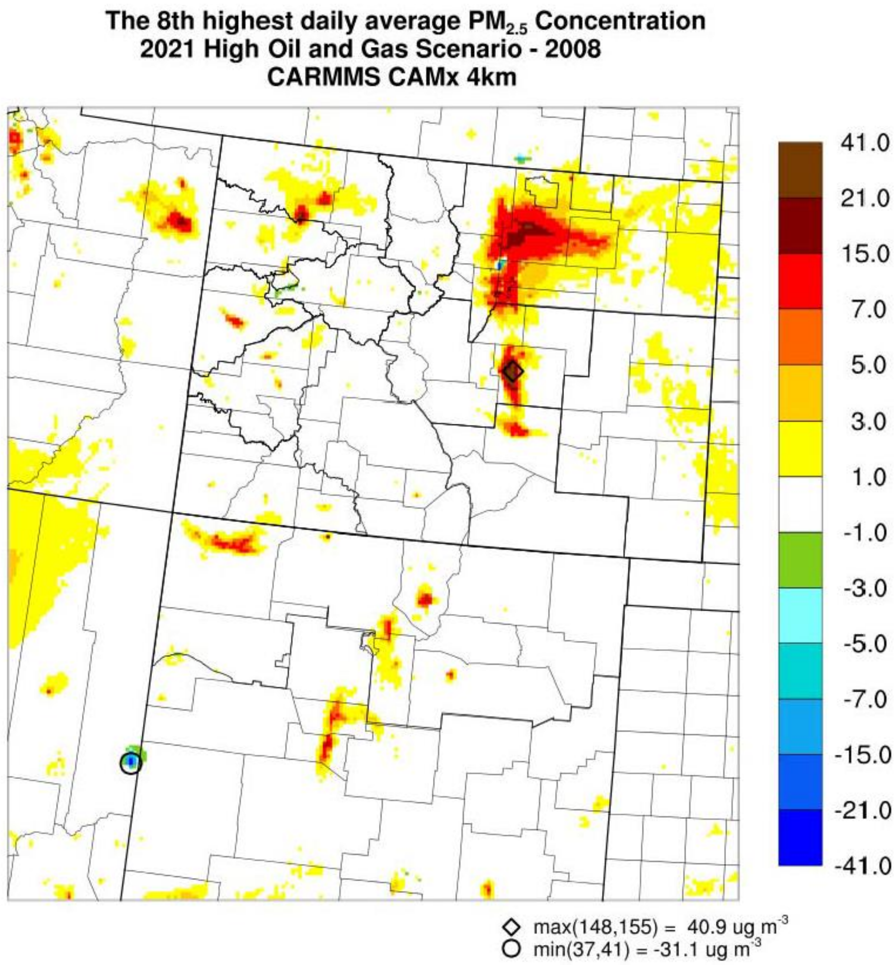

Figure C-2: CARMMS Predicted Changes in Eighth Highest Daily Average $PM_{2.5}$ Concentrations (2021 High Scenario Minus Base Year 2008 Concentrations)

With the exception of $PM_{2.5}$ concentrations near large cities, future mining operations and non-Federal O&G operations, the CARMMS High Scenario full cumulative modeling results show an overall improvement to air quality in the region from year 2008 to year 2021.